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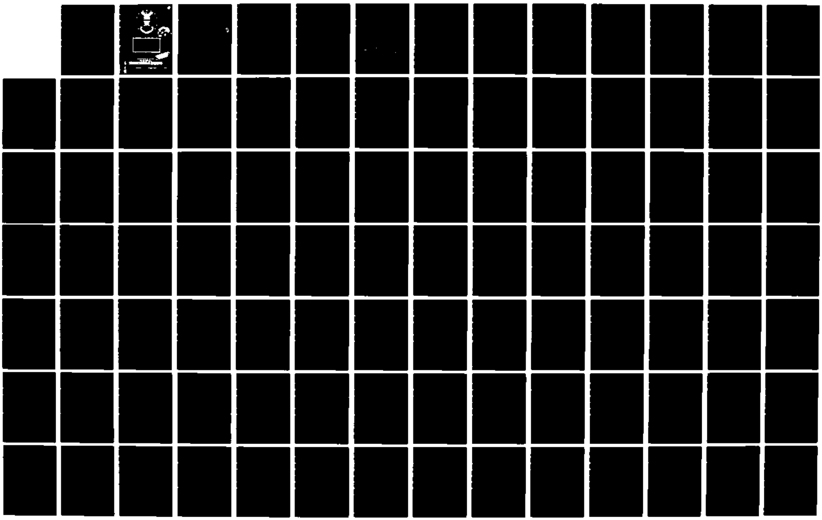

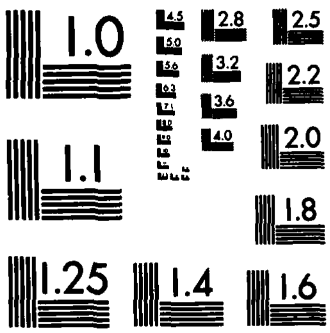

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THE EFFECTS OF THE PRODUCTION ORIENTED MAINTENANCE ORGANIZATION (POMO) CONCEPT ON ADTAC AIRCRAFT MAINTENANCE PRODUCTIVITY AND QUALITY

James B. Amend, Captain, USAF
Larry E. Eriksen, Captain, USAF

LSSR 70-82

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Virtually all USAF tactical fighter and interceptor units work under the AFR 66-5 decentralized POMO concept for aircraft maintenance. This thesis used an aggregation of maintenance data from five ADTAC Fighter Interceptor Squadrons spanning periods preceding and following POMO implementation. Hypotheses reflecting POMO's intended effects on maintenance productivity and quality were then statistically tested using the Analysis of Variance, Duncan's Multiple Range Test, and the Large Sample Test of Significance. The final research results showed that conversion to POMO generally improved aircraft maintenance performance in the ADTAC FISs, but not to any great extent. These findings may possibly be generalizable to other USAF tactical air force operations.

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THE EFFECTS OF THE PRODUCTION ORIENTED MAINTENANCE ORGANIZATION (POMO) CONCEPT ON ADTAC AIRCRAFT MAINTENANCE PRODUCTIVITY AND QUALITY

A Thesis

Presented to the Faculty of the School of Systems and Logistics

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Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

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COMMITTEE CHAIRMAN

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CHAPTER I

INTRODUCTION

> . . . the Soviet Union may see the early and middle 1980s as a period of transitory but useful military advantage. During the period, there will be no shortage of opportunities for potential exploitation by the Soviet Union and its allies and clients. The underdeveloped world is rife with political, economic, and social instabilities; and the developed and underdeveloped nations alike are dependent on oil from the Persian Gulf. It would be optimistic to assume that a militarily superior Soviet Union will be willing to forego all such opportunities to diminish the global presence of the United States and to extend its own influence over additional peoples and resources.
>
> —Military Posture for FY 1982, Joint Chiefs of Staff of the United States Armed Forces

The United States Department of Defense (DOD) faces unprecedented challenges of its military capability in light of an awesome Soviet armed forces growth rate. Perhaps now more than at any other point in American history, the nation and the free world depend on U.S. military might to provide a credible deterrent for armed aggression by the Soviet Union and its allies. A greater emphasis on improving American conventional forces is one major response to this increased Soviet threat. In fact, more plans to increase conventional readiness are currently under way than at any time since the Vietnam era (2:92). Former Secretary of Defense Harold Brown describes

this readiness as "the ability to deploy and to employ our forces effectively without unacceptable delays [2:91]."

The U.S. Air Force tactical fighter forces provide a significant input to overall conventional force readiness. These tactical fighter forces presently consist of 26 active and 11 reserve wings with 2514 assigned fighter aircraft (5:85). The current philosophy for maintaining these aircraft is entitled the Production Oriented Maintenance Organization (POMO). This concept uses a decentralized structure for production decision making and relaxes traditional mechanic job specialization on the flightline. POMO has now been adopted by all tactical fighter and intercepter units in the Tactical Air Command (TAC), U.S. Air Forces in Europe (USAFE), Pacific Air Forces (PACAF), and Alaskan Air Command (AAC) (7:298).

The POMO maintenance concept actually evolved from a broader Air Staff directed maintenance management initiative called the Maintenance Posture Improvement Program (MPIP). The program placed great emphasis on strengthening U.S. Air Force readiness by improving aircraft maintenance effectiveness (7:298). The anticipated increase in effectiveness was to result from POMO's improved rates of flightline productivity and increased maintenance quality (3:2). This research effort is expressly designed to investigate whether or not POMO has

achieved its objectives of increased maintenance productivity and quality.

Problem Statement

Since its implementation during the middle to late 1970s, POMO's effectiveness for increasing maintenance productivity and quality has remained largely unknown. Implementing and adjusting to the new POMO organizational structure was no small task for any tactical fighter wing's maintenance complex. Some degree of disorder and disruption of routine maintenance operations which accompany such a major organizational change was unavoidable. Due to these disturbances, previous research results from POMO's initial periods may be incomplete or invalid. Additionally, no studies of POMO's long term, lasting effects on maintenance productivity and quality have yet been performed. Therefore, the complete effects of changing from the traditional to the POMO organization are not presently known.

Research Objective

The objective of this research effort is to analyze indicators of maintenance productivity and quality to determine whether POMO is actually an improvement over the traditional maintenance organization.

Terms and Definitions

Several aircraft maintenance related terms, acronyms, and phrases are found throughout this research report. Those which require definition or further clarification appear in this section.

1. Air Abort. The failure of an aircraft to complete its assigned mission due to equipment failure or condition (after takeoff).

2. Air Abort Rate. The number of Air Aborts divided by the number of Sorties flown.

3. Average Turnaround Time. The total Turnaround Time divided by the total number of aircraft which are Code-3 Breaks.

4. Cannibalization. The removal of a serviceable part from an aircraft or an uninstalled jet engine for installation on another aircraft or installed engine.

5. Cannibalization Rate. The number of cannibalizations divided by the number of sorties times one-hundred for a specified period.

6. Code-3 Break. An aircraft grounding condition which results from one or more equipment malfunctions or failures. All such discrepancies must be corrected before the code-3 aircraft may be flown again.

7. Code-3 Break Rate. The number of aircraft which are Code-3 Breaks divided by the total of Ground Aborts plus Sorties flown.

8. Full Mission Capable (FMS). A status code meaning that all aircraft systems required to accomplish all primary missions are operable.

9. Full Mission Capable Rate. The total amount of time that all aircraft are Full Mission Capable divided by the total amount of time that the aircraft are physically possessed by a unit.

10. Ground Abort. The failure of an aircraft to launch or take off due to equipment failure or condition after the aircraft has been declared ready for flight.

11. Ground Abort Rate. The number of Ground Aborts divided by the sum of Sorties flown and Ground Aborts.

12. Man-Hours per Flying Hour (MH/FH). The number of maintenance man-hours spent working directly on aircraft or aircraft related subsystems divided by the number of flying hours for a specified period.

13. Not Mission Capable, Maintenance (NMCM). A status code meaning that the aircraft cannot perform any of its primary missions due to required maintenance. Two types of NMCM can occur. NMCM "Unscheduled" (NMCM-U) generally implies that the aircraft developed an unanticipated maintenance problem. A "Scheduled" NMCM condition (NMCM-S) refers to maintenance, grounding the aircraft, which has been planned ahead of time.

14. Not Mission Capable, Maintenance Rate. The total amount of time that aircraft are Not Mission

Capable for Maintenance divided by the total amount of time that the aircraft are physically possessed by a unit. The overall NMCM Rate is the sum of the NMCM Rates for both Scheduled and Unscheduled maintenance.

15. Partial Mission Capable (PMC). A status code meaning that the system or equipment has systems working that are needed to perform at least one, but not all, of its primary missions. It may be further identified by the following reason codes: maintenance (M), supply (S), or both (B).

16. Repeat Discrepancy. Any identical or closely related equipment malfunction or failure of the same component or subsystem which occurs on two successive flights.

17. Repeat Discrepancy Rate. The total number of Repeat Discrepancies divided by the total Sorties flown plus Ground Aborts.

18. Scheduling Effectiveness Rate. The total Sorties scheduled plus unit controllable additions minus unit controllable deviations, divided by the sum of Sorties scheduled plus unit controllable additions. The "unit" here refers to both operations and maintenance organizations.

19. Sortie. The flight of a single aircraft from its initial takeoff to engine shutdown.

20. <u>Turnaround Time</u>. The amount of time required to correct all discrepancies that prevent an aircraft from performing its primary missions.

Research Hypotheses

This investigation divides the subject of POMO effectiveness into two major areas. First, a total of six hypotheses are examined in regard to POMO's hoped-for increases in maintenance productivity. The second category measuring the concept's effectiveness uses four hypotheses dealing with the resulting maintenance quality. The authors hypothesize these ten effects based primarily upon the theorized advantages of implementing POMO. A more in-depth discussion of each hypothesis is provided in Chapter III.

Productivity Hypotheses

1. Full Mission Capable (FMC) Rates will increase.
2. Average Turnaround Times (ATT) will decrease.
3. Not Mission Capable, Maintenance-Unscheduled (NMCM-U) Rates will decrease.
4. Not Mission Capable, Maintenance-Scheduled (NMCM-S) Rates will decrease.
5. Aircraft Scheduling Effectiveness will increase.
6. Maintenance Man-hours per Flying Hour will decrease.

Quality Hypotheses

7. Ground Abort Rates will decrease.

8. Air Abort Rates will decrease.

9. Code-3 Break Rates will decrease.

10. Cannibalization Rates will decrease.

CHAPTER II

BACKGROUND

The very title, Production Oriented Maintenance Organization, infers a focus on effective incorporation of all available maintenance resources in order to increase output. Thousands of Air Force members now work under a POMO environment, since four major air commands with tactical aircraft have transitioned to the concept (7:298). This section provides a brief historical background which traces POMO's development and outlines research efforts directed at assessing the concept's contributions to aircraft maintenance.

Military aircraft maintenance has evolved dramatically throughout the past 70 years in the Army Air Force and the United States Air Force (11:48). Diener and Hood observed that maintenance management concepts have continually oscillated between using mechanics of the total aircraft system and using specialists for each major system (3:7). For example, prior to the crew chief system which began after World War I, Townsend found that the pilot actually maintained his own aircraft (11:48). Soon, however, the pilots began developing air tactics and could no longer be full-time mechanics. The senior

noncommissioned officer and his "crew" became the experts for all aircraft systems (11:49-50). This concept was primarily a generalized approach to maintenance which required mechanics or small teams of mechanics to perform all maintenance functions necessary for the upkeep of their assigned aircraft. Each maintenance technician performed a wide variety of tasks.

A move from a generalized maintenance concept to a specialized maintenance concept began during World War II. The need to repair aircraft quickly and to train thousands of aircraft mechanics produced a time constraint which required immediate attention. Steps were taken to design a "production line" type training program in which mechanics learned only special tasks. Gone were the days when one man could maintain an entire airplane (11:26). A modified crew chief system resulted and specialists became available for repairing specific systems (11:50). This specialist concept persisted after the war in spite of serious maintenance manpower reductions. Less emphasis was placed upon maintaining strong centralized control of systems specialists following the war (3:10). Finally, in 1959, the specialized maintenance concept became standard throughout the Air Force and was governed by Air Force Manual (AFM) 66-1 as the "traditional aircraft maintenance management system" (7:296).

The traditional aircraft maintenance organization, now governed by Air Force Regulation (AFR) 66-1, is still used by the Military Airlift Command and the Strategic Air Command. It is composed of three specialist squadrons plus one squadron of personnel to accomplish the more general crew chief type duties. Aircraft avionics such as radar, navigation, or fire control systems are maintained by specialists in the Avionics Maintenance Squadron (AMS). Two other specialist squadrons are the Field Maintenance Squadron (FMS) and the Munitions Maintenance Squadron (MMS). FMS is tasked to perform all maintenance not associated with avionics or weapons, whether on or off the aircraft. Its branches include such specialists as sheetmetal, engine, and hydraulic repairmen. Aircraft weapons and their support equipment are the responsibility of munitions specialists in MMS. These munitions experts are further divided into branches for both weapons handling and storage. The overall condition of the aircraft, however, remains the responsibility of the individual crew chief who is assigned to the nonspecialized Organizational Maintenance Squadron (OMS). Here lie the routine tasks of inspecting, servicing, launching and recovering the aircraft.

With specialists dispersed to their respective squadrons, a strong Maintenance Control function is required to orchestrate their work loads in detail.

Effectively perpetuating this centralized control is a formidable task, and a weak or inefficient controlling unit can lead to a lack of overall maintenance coordination and productivity (7:298). This problem becomes especially acute for tactical air forces which depend on timely generation and regeneration of a large number of sorties (1:75-76).

The specialist concept does afford several advantages to the maintenance organization, however. For example, economies of scale for labor are realized by pooling like skills in each of the AMS, FMS and MMS branches. Centralizing specialist personnel in this way provides a wealth of experience for tackling even the most complicated maintenance problems. Less specialist equipment is needed in the AFR 66-1 organization since it is also centrally controlled. If specialists are not needed to work with their systems in aircraft on the flightline, they can repair failed components in their own shops. Under the AFR 66-1 organization then, specialists are very versatile in accomplishing either on or off aircraft maintenance for their respective systems. Labor and equipment efficiencies can both be achieved in the highly centralized environment.

The post-Vietnam period brought a military drawdown that directly affected aircraft maintenance performed under the traditional maintenance concept. Defense

outlays as a percent of total federal outlays declined from 43.3 percent in 1968 to 28.8 percent in 1974 (10:135). Cuts took place in every defense category from funding for spare parts to number of authorized personnel. In spite of great decreases in manpower, maintenance organizations were required to achieve even higher levels of maintenance productivity and quality (1:75-76). Difficulties encountered in attaining these levels and in satisfying other mission requirements, such as adequately supporting deployments, prompted the Air Staff to search for a new maintenance management system in 1974. This effort, officially called the Maintenance Posture Improvement Program (MPIP), focused on ways of improving Air Force mobility and increasing limited manpower effectiveness. The Production Oriented Maintenance Organization (POMO) became a productivity centered outgrowth of MPIP initiatives (7:298).

POMO is a fundamental reorganization of the entire traditional maintenance management system. Air Force Regulation (AFR) 66-5 states that POMO is specifically "designed to meet the peculiar combat needs of the tactical air forces [12:p.1-1]." Maintenance Control is relieved of the detailed coordinations required under AFR 66-1 because POMO decision making is placed at the lowest possible level. Further decentralization occurs as maintenance personnel and equipment are divided into

two production elements. The indirect production element performs virtually all off-aircraft maintenance and 10 to 35 percent of all on-aircraft work (7:298), and is composed of the Component Repair Squadron (CRS) and the Equipment Maintenance Squadron (EMS). CRS is responsible for repairing avionics and aircraft systems components plus in-shop jet engine and fabrication activities. Aircraft phase inspection, fuel and egress systems, all ground equipment, and munitions belong to EMS under the POMO concept.

The direct production element of POMO consists of one Aircraft Generation Squadron (AGS) and reveals the most observable departure from the AFR 66-1 specialist concept. AGS exists primarily to launch and recover sorties, but is decidedly different from OMS, its predecessor. In addition to the crew chiefs, AGS is assigned specialists from the former AMS, FMS, and MMS to work on aircraft problems directly related to sortie production. When not performing tasks within their own field, these specialists assist in launch and recovery operations. A major portion of maintenance production decision making now occurs on the flightline itself in AGS.

The planned decentralized structure of a POMO unit theoretically lends itself to several advantages in productivity compared to a centralized traditional maintenance organization. Kenney summed up these advantages

as significant decreases in time required for specialist dispatches and a better control of maintenance work loads by flightline personnel (6:9). He also believed that the greatest potential benefit of the POMO structure lies in quick aircraft repair times which can increase sortie production (6:12). Dr. Larry Wall believed that because the concept lowers the decision-making level to the production units themselves, a new freedom from higher management encourages increased productivity and quality. Junior officers and senior enlisted personnel should perform more effectively with this increased responsibility and accountability (13).

Possible disadvantages of converting to the POMO concept were found in the areas of equipment and personnel resources. As specialists moved from their shop areas to the various AGS branches, more equipment peculiar to their specialties had to be made available to accommodate many new decentralized locations. Specialists assigned to AGS may find it difficult to maintain proficiency in their primary skills since they now regularly perform many crew chief duties. Often a specialist on the flightline may not even be assigned a supervisor of his or her own expertise. Training and skill proficiency problems leading to poor quality of maintenance could be a natural outgrowth of such skill mismatches. Eventually, an AGS branch supervisor may find it difficult to properly man

all work shifts with experienced specialists. Finally, a span of control supervision problem may occur within AGS since new specialist authorizations increased the squadron's size considerably (7:299).

Proponents of POMO are confident that the concept's merits outweigh its disadvantages. Whether or not this argument is valid was investigated by this study in quantitative terms.

Finally, an important consideration of converting to a POMO type organization not addressed in detail within the realm of this study is POMO's effect on the deployment capability of a flying organization. According to AFR 66-5, increasing deployment capability is also a primary goal of POMO (12:p.1-1). Proponents assert that POMO will increase the Air Force's tactical deployment capability.

CHAPTER III

METHODOLOGY

The purpose of this chapter is to describe the methodology used in determining the effects of the POMO maintenance management concept on several selected hypothesis variables. This study was intended to determine whether or not maintenance productivity and quality have been affected by the change in organizational structure. Productivity indicator and quality indicator type hypotheses were analyzed using actual data from aircraft maintenance operations. This chapter includes an overview of the research design, identification and explanation of the test groups, discussion of the hypotheses, data collection, data analysis, and research assumptions and limitations.

Research Design

Numerical data representing aircraft maintenance operations prior to and following POMO implementation was analyzed. The data were divided into three separate periods including a pre-POMO group, post-POMO group, and post-post-POMO group. Using the third (post-post-POMO) set of data allowed more detailed analysis and better

determination of POMO's continuing effects on aircraft maintenance.

The universe for this study was all USAF fighter intercepter units. All active duty USAF F-106 fighter intercepter squadrons (FIS) served as the target population. This study examined five such F-106 squadrons in the United States: the 5th FIS at Minot AFB, North Dakota; the 48th FIS at Langley AFB, Virginia; the 49th FIS at Griffiss AFB, New York; the 87th FIS at K. I. Sawyer AFB, Michigan; and the 318th FIS at McChord AFB, Washington. It should be noted here that the 48th FIS at Langley AFB actually converted from the F-106 to the F-15A in the spring of 1982. However, for purposes of this research effort, the 48th FIS was included in the population since its F-106 maintenance data was available through December of 1981. Therefore, December 1981 was considered the cutoff date for the data time frame in this study.

The three groups of data were used to sample three distinct time periods. Maintenance data in the pre-POMO group were collected from January 1977 through December 1977. The post-POMO group data were taken from January 1979 through December 1979, and the post-post-POMO group data ran from January 1981 through December 1981. Statistical tests were performed on these three data groups to determine whether or not significant differences existed between the periods referenced. Additional statistical

tests were performed comparing the pre-POMO data with the post-post-POMO data to detect any long-term increases or decreases in maintenance management indicators since POMO's institution.

Explanation of Population

The test population of all active duty F-106 fighter intercepter squadrons was selected for several reasons. First, this population was nearly identical to that used in previous POMO research (3:23). Testing the same units could shed additional light on the largely inconclusive results from these earlier studies. These earlier results could also be supported or invalidated by the findings of this current research.

Secondly, the F-106 units were particularly well suited to the POMO concept due to their size and overall structure. An F-106 FIS is normally a tenant unit assigned only 400 to 500 personnel to perform all squadron functions. Individual maintenance branches serve in place of the full-scale maintenance squadrons found in the much larger tactical fighter wing. The smaller scale of the Air Defense-Tactical Air Command (ADTAC) FIS can be a prime contributor to better unit identity, comradery, and a sense of mission among operations and maintenance personnel. Therefore, if POMO decentralized maintenance works, it may work at an ADTAC FIS. It is important to recognize,

however, that POMO's suitability to the F-106 FIS environment may not hold true for an F-15 or F-16 wing. Such a tactical fighter wing is much larger than the typical FIS in terms of both personnel and equipment. Consequently, advantages enjoyed by an FIS may not all be realized by a larger fighter organization.

A third reason for choosing the active duty FISs for a test population was due to their stable operations. The ADTAC air defense mission does not require overseas rotations and the duration of FIS deployments is generally shorter than their tactical fighting counterparts. Additionally, since the F-106 was developed in the mid-1950s, the majority of its maintenance problems have been encountered in the past. The aircraft's longevity is accompanied by a complete maintenance history which provides more stability to FIS aircraft maintenance. Mission stability and aircraft longevity associated with the F-106 FISs allowed less distortion of the maintenance data used to test the research hypotheses of this study.

The overall goal of this research design was to develop a methodology that could evaluate the impact of implementing the POMO concept at an ADTAC FIS. Specific data analysis methods and techniques for the methodology are discussed later in this chapter. First, however, the next section presents discussions of the research

hypotheses and how they relate to the goals of the POMO maintenance concept.

Discussion of Hypotheses

Aircraft maintenance data is created at the lowest working level in each maintenance organization. Periodically, the units then pass the data on to their respective major air commands where it is processed and analyzed. Most of this data is in the quantitative form of rates and numbers which are scrutinized to detect trends in the productivity and quality of current aircraft maintenance. The rates and numbers are all assigned to certain management categories such as "full mission capable" (FMC) rate or "number of air aborts." Hereafter these categories are referred to as research hypothesis variables. Ten such hypothesis variables were selected in this study for analyzing what impact the POMO concept has had on ADTAC aircraft maintenance. Six research hypotheses relate to levels of maintenance productivity and four concern quality levels of aircraft maintenance. Comparing maintenance data for different time periods should indicate whether or not POMO has produced a positive, negative, or neutral effect on ADTAC F-106 FIS maintenance.

Productivity Hypotheses

Hypothesis 1. Full Mission Capable (FMC) Rate will increase. The hypothesis variable is the FMC Rate which

indicates sortie generation capability. As the FMC Rate increases, more mission capable aircraft become available for sortie generation. Provided that manpower levels and FIS contracted flying hours remain constant, a higher FMC Rate produces more available aircraft. Such a boost in the number of aircraft available to be flown is a primary goal of the POMO concept.

Hypothesis 2. Average Turnaround Times (ATT) will decrease. The hypothesis variable is the ATT or the average time required to return an aircraft to flyable status. This figure is calculated by dividing the total turnaround time by the total number of Code-3 breaks. ATT reflects maintenance productivity by revealing increases or decreases in the average repair rate for non-flyable aircraft. More sorties can be produced if aircraft grounded due to maintenance problems are returned to flyable condition at a higher rate. The POMO concept suggests that ATT will be less with its new organizational structure. Valuable repair time previously lost waiting for specialists to be dispatched is now recovered since many specialists are assigned to flightline units. Thus, under POMO the ATT decreases as maintenance productivity increases.

Hypothesis 3. Not Mission Capable, Maintenance-Unscheduled (NMCM-U) Rates will decrease. The hypothesis

variable is the NMCM-U Rate. POMO claims to better utilize maintenance personnel by assigning specialists directly to the flightline. Time and manpower efficiencies gained by the new arrangement will decrease NMCM time required to correct the unscheduled (U) maintenance problems. The potential for generating and flying more sorties is greater with a lower NMCM-U Rate.

Hypothesis 4. Not Mission Capable, Maintenance-Scheduled (NMCM-S) Rates will decrease. The hypothesis variable is the NMCM-S Rate. POMO's improved maintenance productivity will allow aircraft grounded for routine scheduled maintenance to be returned to service more quickly. Thus, less NMCM time is required and the NMCM-S Rate will decrease.

It should be noted that, as more sorties are generated and flown, more maintenance discrepancies, which must be repaired, occur. Flying hours between routine scheduled maintenance are also expended more rapidly. However, in peacetime the number of sorties scheduled depends on flying hour authorizations allotted to units by their respective major commands. When actual contracted flying hours were subjected to Duncan's Multiple Range Test, means for the data were nearly identical for the pre-POMO, 461 hours; and post-post-POMO, 464 hours. Period 2 (post-POMO) had a higher mean of 492 hours

contracted (see Appendix B). This increased flying time may partially account for the lower Average Turnaround Time and higher Air Abort rate and Code-3 rate for Period 2 (Table 1 in Chapter IV). In the long run, however, contract flying hours remained virtually unchanged.

Hypothesis 5. Aircraft Scheduling Effectiveness will increase. The hypothesis variable is the Scheduling Effectiveness Rate or total sorties scheduled and flown divided by total sorties scheduled. A major premise of the POMO concept is that there will be an increase in the effective use of all maintenance resources. Theoretically, aircraft schedulers can make better forecasts for assigning tail numbers to a flying schedule since, with a higher FMC Rate and lower NMCM Rates, more aircraft are available to be flown.

Hypothesis 6. Man-hours per Flying Hour (MH/FH) will decrease. The hypothesis variable, MH/FH, is the ratio of direct maintenance man-hours to hours flown by an FIS for a specified period. The POMO concept suggests that assigning certain specialists to the flightline is a more efficient use of manpower. These specialists can perform in their own fields of expertise, but can also assist in generalized maintenance tasks such as aircraft inspections and routine servicing. Maintenance productivity can be increased in the following two ways using

this hypothesis variable: (1) increasing the number of sorties while holding the amount of man-hours constant, or (2) flying the same number of sorties but showing a decreased amount of maintenance man-hours expended. In either case, POMO advocates claim that Man-hours per Flying Hour will decrease.

Quality Hypotheses

Hypothesis 7. Ground Abort Rates will decrease. The hypothesis variable is Ground Abort Rate which is found by dividing the number of ground aborts by the total of sorties flown plus ground aborts. Many ground aborts occur due to entirely unpredictable maintenance problems. However, such an abort can also be caused by carelessness or "quick fix" type repairs. Therefore, a low number of ground aborts may indicate high maintenance quality. Hence, a decrease in the Ground Abort Rate will reflect an increase in the quality of maintenance performed.

Hypothesis 8. Air Abort Rates will decrease. The hypothesis variable is the Air Abort Rate defined as the number of air aborts per total sorties flown. A decrease in the Air Abort Rate will indicate an increase in maintenance quality for the same reasons cited above with a decrease in the Ground Abort Rate.

Hypothesis 9. Code-3 Break Rates will decrease. The hypothesis variable is the Code-3 Break Rate which is the number of code-3 aircraft divided by the total ground aborts plus sorties flown. Theoretically, if an aircraft is maintained with high quality standards it will be less liable to develop a system malfunction. Therefore, since POMO claims to improve maintenance quality, the grounding code-3 break will happen less frequently and its break rate will be lower.

Hypothesis 10. Cannibalization Rates will decrease. The hypothesis variable is the Cannibalization Rate defined as cannibalizations per sorties flown by time period. If maintenance quality is truly stressed in a POMO organization, managers at the lower production levels will be more available to preclude indiscriminant cannibalizations. The cannibalized part or the components that surround it always run the risk of being damaged during hasty removal and replacement actions. Maintenance managers also realize that cannibalization actions always generate additional work, even in the case of a so-called "convenience cann." This hypothesis is more directly affected by management actions than those listed previously.

Data Collection

The data for this research were obtained from Headquarters ADTAC/LGXI and from the individual monthly

maintenance summaries prepared by each FIS. Inclusive dates for this data were from December 1977 through December 1981. As mentioned previously, the data were broken down into three specific time periods or groups: pre-POMO, post-POMO, and post-post-POMO. With data obtained, the next step was to specifically discuss the methods used for data analysis.

Data Analysis

Data for each hypothesis variable were analyzed separately for all F-106 FISs in the aggregate. For example, the NMCM-U rate variable was analyzed by combining pre-POMO rates for all five FISs and comparing them with the combined rates for post-POMO and post-post-POMO data from all five FISs. Combining all FIS data this way better revealed significant differences between groups. These differences were due to the POMO changeover itself rather than the individual effects from each FIS. A second part of the data analysis compared pre-POMO data for hypotheses variables with post-post-POMO data. This comparison was also designed to reveal any changes in the hypotheses variables for the long run. Several statistical tests were designed to show an increase, decrease, or no change in maintenance productivity and quality due to POMO. General conclusions were then made about the

productivity and quality of maintenance under the POMO concept after performing these tests on the data.

All hypotheses variables were individually analyzed using parametric statistical tests. Previous research analyzed similar hypotheses variables by observing differences between pre-POMO and post-POMO data (3:40-42). However, by observing the differences between pre-POMO, post-POMO and post-post-POMO data, this study went beyond this earlier research. The present study offered a second feature by comparing pre-POMO data to post-post-POMO data for determining whether POMO has had any long-term impact on maintenance productivity and quality.

The first part of the analysis of the data involved using the parametric statistical test, One-Way Analysis of Variance, with Duncan's Multiple Range Test to determine if significant differences existed between the means of the hypothesis variable data for each of the three periods: pre-, post-, and post-post-POMO. These tests indicated whether or not there was a significant statistical difference between the means of the data in periods for each variable. When there was a significant difference, it could be concluded that the POMO concept was a possible cause of this difference.

The One-Way Analysis of Variance is a parametric statistical test used for comparing two or more population or sample means.

The general hypotheses are:

H_o: $\mu_1 = \mu_2 = \mu_3 \cdots = \mu_k$

H_a: at least two of the means differ

Test statistic $F = \frac{MST}{MSE}$

Rejection region $F > F_{\alpha,(k-1),(n-k)}$

where k is the numerator degrees of freedom associated with the MST, and (n-k) is the denominator degrees of freedom associated with the MSE (8:461).

The Duncan's Multiple Range Test is a parametric statistical test comparing the means of k subsets of data. A key advantage of this test is its control of Type I errors (deciding in favor of the research hypothesis when in fact the null hypothesis is true). Duncan's Multiple Range Test also groups the means of various sets of data into the same subsets if the means are not significantly different.

The general hypothesis is:

1. Order the means of the sets of data $\overline{X}_{(1)}$ = smallest, $\overline{X}_{(k)}$ = largest.

2. Define $R = \frac{\overline{X}_{(j)} - \overline{X}_{(i)}}{s/\sqrt{n_L}}$ $\quad j > i$

3. H_o: $\mu_{(j)} = \mu_{(i)}$

H_a: $\mu_{(j)} > \mu_{(i)}$

If H_o is true then Duncan's multiple range tables provide r where $P(R > r|p,f) = .05$ or $.01$ (9:427-429).

The preceding tests were done on all hypothesis variables to determine whether or not significant differences existed among the means of the three groups of data for each hypothesis variable.

The second part of this research data analysis technique used the parametric test, "Large Sample Test of Significance." This test could reveal any significant difference in the hypothesis variables between pre-POMO and post-post-POMO data. Ultimately, the Large Sample Test of Significance was used to determine what effect the POMO concept had on the research hypothesis variables. More specifically, were there increases, decreases, or no change on the hypothesis variables because of the implementation of POMO.

The Large Sample Test of Significance of an hypothesis for $\mu_1 - \mu_2 = 0$ was used to detect any difference between the means of pre-POMO and post-post-POMO hypothesis variables. The hypothesis variables were analyzed using one-tailed hypothesis test rejection regions with a significance level of $\alpha = 0.05$ in all cases. The one-tailed test was used because it reflects whether increases,

decreases or no change occurred between the pre-POMO data and the post-post-POMO data.

The general test hypothesis for the Large Sample test of an hypothesis for $\mu_1 - \mu_2$ is:

H_o: $(\mu_1 - \mu_2) = 0$ no change

H_a: $(\mu_1 - \mu_2) < 0$ increase

$(\mu_1 - \mu_2) > 0$ decrease

Test statistic

$$Z = \frac{(\overline{X}_1 - \overline{X}_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

with (n_1+n_2-2) d.f.

Rejection region:

$Z_{obs} < -Z_\alpha$ increase

$Z_{obs} > Z_\alpha$ decrease

where α is obtained from statistical tables such that $P(Z_{obs} > Z_\alpha) = .05$.

Properties of the sampling distribution of $(\overline{X}_1 - \overline{X}_2)$ for Large Sample test hypothesis are as follows:

1. The sampling distribution of $(\overline{X}_1 - \overline{X}_2)$ is approximately normal for large samples.

2. The mean of the sampling distribution of $(\bar{X}_1 - \bar{X}_2)$ is $(\mu_1 - \mu_2)$.

3. If the two samples are independent the standard deviation of the sampling distribution is

$$\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

where σ_1^2 and σ_2^2 represented by s_1^2 and s_2^2 are the variances of the two populations being sampled and n_1 and n_2 are the representative sample sizes (8:247-248).

The research hypothesis variables were analyzed at the 0.05 significance level with the premise that the POMO concept should contribute to increased aircraft maintenance productivity and quality.

For hypothesis 2, 3, 4, 6, 7, 8, 9, and 10, improved maintenance performance was reflected by a decrease in the hypothesis variable from the pre-POMO period to the post-post-POMO period. The hypothesis alternatives were:

$$H_o: \mu_1 - \mu_2 = 0 \quad \text{no change}$$

$$H_a: \mu_1 - \mu_2 > 0 \quad \text{decrease}$$

For hypotheses 1 and 5 improved maintenance performance was reflected by an increase in the hypothesis variable

from the pre-POMO to the post-post-POMO period. The hypothesis alternatives were:

$$H_o: \mu_1 - \mu_2 = 0 \quad \text{no change}$$

$$H_a: \mu_1 - \mu_2 < 0 \quad \text{increase}$$

The hypothesis showed whether or not there was no change, a decrease, or an increase in the pre-POMO and post-POMO hypothesis variables. These results depended on the sign of the computed test statistic and whether or not it fell into the rejection region of the null hypothesis. For example, if the test statistic (Z) for a particular hypothesis variable did not fall within the rejection region, insufficient evidence existed at the $\alpha = .05$ level to reject the null hypothesis. The conclusion was that no change occurred in the pre-POMO and post-post-POMO data. If the test statistic (Z) fell into the rejection region, the null hypothesis (H_o) was rejected. It was then concluded that either an increase or decrease occurred in the pre-POMO and post-post-POMO data means, depending on the sign of the test statistic. The results of data analysis are discussed in Chapter IV.

Assumptions and Limitations

The purpose of this section is to discuss the assumptions and limitations encountered with this research design.

Assumptions

The major assumption of this research effort was that maintenance productivity and quality variables were included in the study only if they were directly related to and would be significantly affected by the implementation of the POMO. In other words, the POMO concept was assumed to be the primary factor impacting the hypotheses variables.

Specific assumptions include:

1. Maintenance manpower availability has not significantly changed throughout the three periods. Previous research and communications with manpower experts at all FISs and Headquarters ADTAC, indicated average manpower levels of 466 for Period 1, 450 for Period 2, and 470 for Period 3 (3:111).

2. Skill levels of the maintenance personnel have not changed significantly over the three periods (3:111).

Limitations

A major limitation of this research concerned the quality hypotheses. The difficulty lay in attempting to represent quali*ative maintenance management concepts in the quantitative forms of numerical data and statistics.

This study also relied on the integrity of ADTAC Maintenance Data Collection (MDC) records used for

developing the input data base. Inaccurate F-106 maintenance data could have yielded statistical results which failed to represent reality.

Another problem arose in categorizing FISs precisely into pre-POMO and post-POMO periods since MDC data was only available from January 1977 through December 1981. For example, the 48th FIS at Langley AFB was actually well into POMO conversion between January 1977 to December 1977, the standard pre-POMO cutoff dates.

CHAPTER IV

DATA ANALYSIS AND RESULTS

An analysis of maintenance data from the five ADTAC FISs provided both significant and insignificant statistical results from the hypotheses tested. This chapter presents and discusses the data analysis used to support or to reject each of the ten research hypotheses concerning POMO's impact on aircraft maintenance. The chapter also includes a data analysis overview and a discussion of the statistical test results (One-way ANOVA, Duncan's Multiple Range and Large Sample Test of Significance) for each hypothesis.

Overview of Data Analysis

The overall data analysis for this study follows the two-part strategy presented in Chapter III. Data for each hypothesis variable for all five FISs were grouped according to time period. Statistical tests were then performed to determine whether or not significant differences existed between the time periods of combined data. Each discussion of hypothesis test results first gives an outcome of the analysis of variance (One-way ANOVA) for the pre-POMO, post-POMO and post-post-POMO periods of data. The second part of each discussion compares

pre-POMO with post-post-POMO data using the Large Sample Test of Significance. Raw data inputs for the tests are identified by hypothesis variable and FIS for each pre-, post- or post-post-POMO period. Appendix A contains a complete list of the raw data.

Table 1 shows an aggregation F-106 FIS data for each research hypothesis variable. The table also lists means and standard deviations for the variables in each of the three periods. Results of the one-way analysis of variance are presented in Table 2. Here, individual hypothesis variable F-ratios are used to either confirm or deny significant changes in the variables among the different periods. Actual computer results for this test are grouped by research hypothesis and are provided in Appendix B. Table 3 presents the Duncan's Multiple Range Test results. This table breaks hypothesis variable means into groups when significant differences occur among the means. The computer results of Duncan's test are also found in Appendix B.

Table 4 presents results of the Large Sample Test of Significance which compares pre-POMO and post-post-POMO data (period 1 versus period 3) for each hypothesis variable. Significant differences in periods for each variable on the table are either supported or rejected using the appropriate test statistic (Z_{obs}). All statistical tests are conducted at a 0.05 level of significance. The

TABLE 1

INITIAL ANALYSIS OF HYPOTHESES

		Pre-POMO (Period 1 Jan-Dec 77)		Post-POMO (Period 2 Jan-Dec 79)		Post-Post-POMO (Period 3 Jan-Dec 81)	
Hypothesis Number	Hypothesis Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1	FMC Rate	63.74	7.57	54.99	11.10	47.46	13.12
2	Average Turn Time	10.48	3.82	8.51	2.76	11.60	3.92
3	NMCM-U Rate	16.14	5.31	11.54	5.01	16.52	5.53
4	NMCM-S Rate	9.04	3.49	3.17	2.24	3.84	2.15
5	Scheduling Effectiveness Rate	71.95	10.08	79.06	9.99	78.09	8.03
6	Man-hours per Flying Hour	41.79	8.16	45.34	9.62	45.89	11.91
7	Ground Abort Rate	3.22	1.85	2.97	1.68	2.68	1.57
8	Air Abort Rate	0.93	0.77	1.13	0.77	0.56	0.49
9	Code-3 Break Rate	36.32	9.94	39.42	7.38	32.07	6.58
10	Cannibalization Rate	6.09	3.45	7.56	3.98	7.59	5.75

TABLE 2

RESULTS OF ANALYSIS OF VARIANCE
(α = .05)

Hypothesis Number	Hypothesis Name	F-Ratio	Rejection Region (F_α)	Significant Difference Between at Least Two of the Periods
1	FMC Rate	33.87	$F_{.05}$, 2, 177=3.04	Yes
2	Average Turn Time	11.69	$F_{.05}$, 2, 177=3.04	Yes
3	NMCM-U Rate	13.76	$F_{.05}$, 2, 147=3.06	Yes
4	NMCM-S Rate	70.97	$F_{.05}$, 2, 147=3.06	Yes
5	Scheduling Effectiveness Rate	9.23	$F_{.05}$, 2, 162=3.05	Yes
6	Man-hours per Flying Hour	1.78	$F_{.05}$, 2, 105=3.09	No
7	Ground Abort Rate	1.35	$F_{.05}$, 2, 162=3.05	No
8	Air Abort Rate	9.94	$F_{.05}$, 2, 162=3.05	Yes
9	Code-3 Break Rate	11.45	$F_{.05}$, 2, 162=3.05	Yes
10	Cannibalization Rate	1.98	$F_{.05}$, 2, 162=3.05	No

TABLE 3

RESULTS OF DUNCAN'S MULTIPLE RANGE TEST
(α = .05)

Hypothesis Number	Hypothesis Name	Subsets (If more than one are from smallest to largest)		
1	FMC Rate	Subset 1 Period 3 47.46	Subset 2 Period 2 54.99	Subset 3 Period 1 63.74
2	Average Turn Time	Subset 1 Period 2 8.51	Subset 2 Period 1 10.48 Period 3 11.60	
3	NMCM-U Rate	Subset 1 Period 2 11.54	Subset 2 Period 1 16.14 Period 3 16.52	
4	NMCM-S Rate	Subset 1 Period 2 3.17 Period 3 3.84	Subset 2 Period 1 9.04	
5	Scheduling Effectiveness Rate	Subset 1 Period 1 71.95	Subset 2 Period 3 78.09 Period 2 79.06	

TABLE 3--Continued

Hypothesis Number	Hypothesis Name	Subsets (If more than one are from smallest to largest)		
6	Man-hours per Flying Hour	Subset 1		
		Period 1	Period 2	Period 3
		41.79	45.34	45.89
7	Ground Abort Rate	Subset 1		
		Period 3	Period 2	Period 1
		2.68	2.97	3.21
8	Air Abort Rate	Subset 1	Subset 2	
		Period 3	Period 1	Period 2
		0.56	0.93	1.13
9	Code-3 Break Rate	Subset 1	Subset 2	Subset 3
		Period 3	Period 1	Period 2
		32.07	36.32	39.42
10	Cannibalization Rate	Subset 1		
		Period 1	Period 2	Period 3
		6.09	7.56	7.59

TABLE 4

RESULTS OF LARGE SAMPLE TEST OF SIGNIFICANCE
(Comparison of Means Period 1 vs Period 3)

Hypothesis Number	Hypothesis Name	$Z_{observed}$	Rejection Region	Significant Difference	Direction of Change Period 1 to Period 3
1	FMC Rate	8.32	> 1.645 < -1.645	Yes	Decrease
2	Average Turn Time	-1.59	> 1.645 < -1.645	No	No Change
3	NMCM-U Rate	-0.35	> 1.645 < -1.645	No	No Change
4	NMCM-S Rate	8.97	> 1.645 < -1.645	Yes	Decrease
5	Scheduling Effectiveness Rate	-3.53	> 1.645 < -1.645	Yes	Increase
6	Man-hours per Flying Hour	-1.70	> 1.645 < -1.645	Yes	Increase
7	Ground Abort Rate	1.78	> 1.645 < -1.645	Yes	Decrease

TABLE 4--Continued

Hypothesis Number	Hypothesis Name	$z_{observed}$	Rejection Region	Significant Difference	Direction of Change Period 1 to Period 3
8	Air Abort Rate	3.00	> 1.645 <-1.645	Yes	Decrease
9	Code-3 Break Rate	2.65	> 1.645 <-1.645	Yes	Decrease
10	Cannibalization Rate	-1.65	> 1.645 <-1.645	Yes	Increase

following section discusses and evaluates these statistical test results for each research hypothesis.

Results of Statistical Tests for the Hypothesis Variables

Productivity Hypotheses

Hypothesis 1. FMC Rate. POMO will increase the FMC Rate. The results of the Analysis of Variance test (ANOVA) as shown in Table 2 produced an F-ratio of 33.87. This led to a rejection of the null hypothesis $F = 33.87 > F_{.05}, 2, 177 = 3.00$ and a conclusion that at least two of the FMC Rates means differed for the three periods. This finding was supported by Duncan's Multiple Range Test which separated the means into three distinct groups (Table 3).

The results of the Large Sample Test of Significance gave a Z value of 8.32. This value also allowed rejection of the null hypothesis $(\mu_1 - \mu_2) = 0$:

Test statistic $Z = 8.32$

Rejection region $Z_{obs} < -Z_\alpha$ increase

$Z_{obs} > Z_\alpha$ decrease

$Z_\infty = 1.645$

Reject H_o; $8.32 > 1.645$.

However, this test disclosed a significant decrease in the hypothesis variable value rather than the increase in FMC Rates predicted with POMO's implementation. Table 1 shows rates of 63.7 percent for pre-POMO and 47.5 percent for post-post-POMO periods. Because of this decrease, further

tests were conducted on additional non-hypothesis variables including Partial Mission Capable (PMC) Rate and Partial Mission Capable Supply (PMCS) Rates. When the PMC Rates were added to the FMC Rates no significant differences were found between the means of data for pre-POMO and post-post-POMO periods. Adding PMC to FMC Rates for the post-POMO period did show an increase for period 2 only (see Appendix B). Further analysis revealed that the PMC Rate increase was caused largely by significantly higher Partial Mission Capable, Supply (PMCS) Rates. From 1977 through 1981 PMCS Rates grew from 3.1 percent to 14 percent. Partial Mission Capable, Maintenance (PMCM) Rates also increased during this time frame from 1.4 percent to 3.9 percent (Appendix B). Though this is a significant increase, it did not cause as much of a change in PMC Rates as did the increase in PMCS Rates.

Thus, considered alone, FMC Rates decreased significantly and failed to support hypothesis 1 that POMO would increase them. However, combining FMC and PMC rate data disclosed no significant long-term difference between pre-POMO and post-post-POMO periods.

Hypothesis 2. Average Turnaround Times. POMO will decrease Average Turnaround Times. Results of the ANOVA for hypothesis 2 gave the following means for the ATT hypothesis variable: pre-POMO (period 1) 10.8,

post-POMO (period 2) 8.51, and post-post-POMO (period 3 11.60 (Table 1). The F-ratio was 11.69 (Table 2) which led to a rejection of the null hypothesis. In this case, Duncan's Multiple Range Test grouped periods 1 and 3 together (showing no significant difference), and grouped period 2 by itself (Table 3).

Results of the Large Sample Test were (Table 4):

Test statistic $Z = -1.59$

Rejection region $Z > 1.645, < -1.645$

Since Z_{obs} did not fall within the rejection region, insufficient evidence existed to reject the null hypothesis. This result indicated that there were no significant differences between the Average Turnaround Times for pre-POMO and post-post-POMO periods.

Thus, the results from these tests failed to support hypothesis 2 that POMO will decrease ATT. Although there was a slight increase in times from period 1 to period 2, the ATT revealed no significant change between period 1 and period 3.

<u>Hypothesis 3</u>. Not Mission Capable Maintenance-Unscheduled. POMO will decrease NMCM-U Rates. As revealed in Table 1, the means for the NMCM-U Rates were: period 1, 16.14; period 2, 11.54; and period 3, 16.52. The ANOVA provided an F-ratio of 13.76 (Table 2) resulting

in a rejection of the null hypothesis $F = 13.76 > F_{.05}, 2, 147$ (3.00). Duncan's Multiple Range Test grouped the means from periods 1 and 3 together, and grouped the mean of period 2 by itself (Table 3).

The Large Sample Test of Significance results were (Table 4):

Test statistic $Z = -0.35$

Rejection region $Z > 1.645, < -1.645$

Z_{obs} did not fall within the rejection region so it was concluded that no significant differences existed between the NMCM-U Rates for periods 1 and 3.

The results of the statistical tests for hypothesis 3, NMCM-U Rates, revealed no significant change in the data for the first and third periods. Although the Analysis of Variance revealed a decrease in NMCM-U Rates for period 2, the rates increased again in period 3 to match the pre-POMO level. Therefore, the overall NMCM-U Rates were not significantly affected by the POMO concept.

Hypothesis 4. Not Mission Capable Maintenance-Scheduled (NMCM-S) Rates. POMO will decrease NMCM-S Rates. Data analysis of this hypothesis variable resulted in means of period 1, 9.04; period 2, 3.17; and period 3, 3.84 (Table 1).

The ANOVA results provided an F-ratio of 70.97 (Table 2) which led to a rejection of the null hypothesis. This large F-ratio indicated a rather significant difference in the data means. Therefore, the researchers concluded that at least two of the means for the three periods differed. $F = 70.97 > F_{.05}, 2, 147\ (3.00)$. Duncan's Multiple Range Test supported these findings by grouping the means of periods 2 and 3 together and period 1 alone (Table 3).

The results of the Large Sample Test for Significance also revealed a significant difference between the means of NMCM-S Rates for pre-POMO and post-post-POMO periods (Table 4).

Test statistic $Z = 8.97$

Rejection $Z > 1.645, < -1.645$

Since $Z_{obs} = 8.97 > 1.645$, the null hypothesis was rejected and it was concluded that the NMCM-S Rates significantly decreased from period 1 to period 3.

Overall, the results from all tests on hypothesis variable 4 (NMCM-S Rates) statistically supported the conclusion that the POMO concept appears to have decreased the NMCM-S Rates.

Hypothesis 5. Aircraft Scheduling Effectiveness. POMO will increase Scheduling Effectiveness Rates. Means of the Scheduling Effectiveness data were: period 1, 71.95;

period 2, 79.06; and period 3, 78.09 (Table 1). The ANOVA results shown in Table 2 presented an F-ratio of 9.23 with a rejection of the null hypothesis and conclusion that at least two of the group means differed. Results of Duncan's Multiple Range Test grouped the means of periods 2 and 3 together and grouped period 1 individually.

The results of the Large Sample Test for Significance of period 1 versus period 3 were as follows:

Test statistic $Z = -3.53$

Rejection region $Z > 1.645, < -1.645$

A $Z_{obs} = -3.53 < -1.645$ rejected the null hypothesis and concluded that Scheduling Effectiveness significantly increased from the pre-POMO to the post-post-POMO period.

Results from the analysis of the statistical tests for Scheduling Effectiveness indicated support for hypothesis 4.

Therefore, the researchers concluded that ADTAC Scheduling Effectiveness increased under the POMO concept.

Hypothesis 6. Man-hours per Flying Hour (MH/FH). POMO will decrease Maintenance Man-hours per Flying Hour. The means of this data group were 41.8 for period 1, 45.3 for period 2 and 45.9 for period 3. Man-hour per Flying Hour data prior to 1979 were available at only three of the five FISs. This problem did not totally invalidate the data that were gathered for testing this research

hypothesis, however. The rejection region for the null hypothesis in the Analysis of Variance was $F_{.05}$, 2, 105 = 3.08 instead of 3.00. The ANOVA F-ratio of 1.78 for hypothesis 6 (Table 2) was insufficient to reject the null hypothesis. Duncan's Multiple Range Test (Table 3) grouped the means of all three periods together. Such a single grouping indicated that no significant difference existed among the means for the three periods.

Results of the Large Sample Test for Significance (Table 4) were:

Test statistic = -1.70

Rejection region $Z > 1.645, < -1.645$

$Z_{obs} = -1.70 < -1.645$, which fell within the rejection region indicating a significant increase in Man-hours per Flying Hour from period 1 to period 3.

Overall results from the statistical tests on the MH/FH hypothesis variable revealed two separate outcomes. The ANOVA and Duncan's tests provided no significant difference between the three periods, while the Large Sample Test of Significance detected a significant, though small, increase in MH/FH from period 1 to period 3. None of the test results supported hypothesis 6 that MH/FH would decrease with POMO. As mentioned previously in the assumptions section, communications with Headquarters ADTAC indicated that manpower levels have not changed significantly from 1977 through 1981.

Quality Hypotheses

Hypothesis 7. Ground Abort Rates. POMO will decrease Ground Abort Rates. The means of the Ground Abort Rates for the three periods (Table 1) were: period 1, 3.22, period 2, 2.97; and period 3, 2.68. The ANOVA F-ratio of 1.35 (Table 2) was insufficient to reject the null hypothesis. Duncan's Multiple Range Test (Table 3) supported this result by grouping the means of the three periods together, indicating no significant difference.

The results of the Large Sample Test of Significance were (Table 4):

Test statistic $Z = 1.78$

Rejection region $Z > 1.645, < -1.645$

The test statistic fell within the rejection region indicating a significant decrease in the means of the hypothesis variable between pre-POMO and post-post-POMO periods.

Overall results for the data analysis of hypothesis 7 disclosed no significant change in the Ground Abort Rates with ANOVA or Duncan's. However, the Large Sample Test of Significance for period 1 versus period 3 supported hypothesis 7 that the POMO concept would decrease Ground Abort Rates.

Hypothesis 8. Air Abort Rates. POMO will decrease Air Abort Rates. As shown in Table 1 the means for the Air Abort Rates were: period 1, 0.93; period 2, 1.13; and period 3, 0.56. The Analysis of Variance results provided an F-ratio of 9.94 (Table 2) and therefore a rejection of the null hypothesis. Duncan's Multiple Range Test supported this result by grouping period 3 alone and period 1 with period 2 (Table 3).

Results of the Large Sample Test of Significance (from Table 4) were:

Test statistic $Z = 3.00$

Rejection region $Z > 1.645, < -1.645$

$Z_{obs} > 1.645$ necessitated rejecting the null hypothesis and concluding that a significant decrease occurred in the means of the data between period 1 and period 3.

Overall statistical analysis of the hypothesis variable supported hypothesis 8 that POMO would decrease Air Abort Rates.

Hypothesis 9. Code-3 Break Rates. POMO will reduce Code-3 Break Rates. Data analysis from Table 1 gave the means for the Code-3 Break Rates as follows: period 1, 36.3; period 2, 39.4; and period 3, 32.1. The F-ratio from the ANOVA results was 11.45 (Table 2), a value which caused rejection of the null hypothesis.

Duncan's Multiple Range Test results from Table 3 separated the means into three separate groups.

Results of the Large Sample Test of Significance (Table 4) were:

Test statistic $Z = 2.65$

Rejection region $Z > 1.645, < -1.645$

$Z_{obs} = 2.65 > 1.645$ led to a rejection of the null hypothesis and a conclusion that a significant decrease in Code-3 Break Rates occurred from period 1 to period 3.

Overall results of the statistical tests on the Code-3 Break Rates supported hypothesis 9 that the POMO concept would reduce the Code-3 Break Rates.

<u>Hypothesis 10</u>. Cannibalization Rates (Cann Rates). POMO will reduce Cann Rates. From Table 1 the Cann Rates means for the three test periods were: period 1, 6.09; period 2, 7.56; and period 3, 7.59. The ANOVA (Table 2) resulted in an F-ratio of 1.98 which indicated insufficient evidence for rejection of the null hypothesis. Duncan's Multiple Range Test supported this conclusion by grouping the means of the three periods together.

The Large Sample Test of Significance results from Table 4 were:

Test statistic $Z = -1.65$

Rejection region $Z > 1.645, < 1.645$

$Z_{obs} = -1.65, < 1.645$ and led to a rejection of the null hypothesis.

The results for all statistical tests on FIS data for Cannibalization Rates did not agree. The ANOVA and Duncan's tests resulted in insufficient evidence to support any significant change in the rates among the three periods. The Large Sample Test of Significance, however, indicated a slight increase in Cannibalization Rates from period 1 to period 3.

The next chapter discusses final conclusions concerning POMO's effect on these research variables.

CHAPTER V

CONCLUSIONS

This chapter provides final research conclusions concerning how implementing POMO has impacted ADTAC aircraft maintenance productivity and quality. First, the research findings are summarized according to their productivity and quality categories. Overall conclusions for POMO and their implications for managers are then presented. Finally, recommendations and topics for suggested future research are identified.

Productivity

ADTAC's conversion to the POMO concept has reaped limited benefits in terms of maintenance productivity. Higher productivity levels were indicated by a significant drop in the Not Mission Capable, Maintenance-Scheduled (NMCM-S) Rate and an increase in aircraft Scheduling Effectiveness (Table 5). The four remaining productivity-oriented research hypotheses, however, were not supported by statistical results.

Hypothesis 1

POMO will increase the FMC Rate. The research did not support this hypothesis. In fact, the FMC Rate

TABLE 5

SUMMARY OF ALL ANALYSES

Hypothesis Number	Hypothesis Name	ANOVA Significant Difference	DUNCAN'S Significant Difference	LARGE SAMPLE TEST OF SIG. Direction of Change Period 1 vs Period 3	Overall Conclusion	Support for Research Hypothesis
HYPOTHESES RELATING TO PRODUCTION CAPABILITY						
1	FMC Rate	Yes	Yes	Decrease	POMO appears to have decreased performance	No
2	Average Turn Time	Yes	Yes	No Change	Inconclusive results	No
3	NMCM-U Rate	Yes	Yes	No Change	Inconclusive results	No
4	NMCM-S Rate	Yes	Yes	Decrease	POMO appears to have improved performance	Yes
5	Scheduling Effectiveness Rate	Yes	Yes	Increase	POMO appears to have improved performance	Yes
6	Man-hours per Flying Hour	No	No	Increase	Inconclusive results	No

TABLE 5--Continued

Hypothesis Number	Hypothesis Name	ANOVA Significant Difference	DUNCAN'S Significant Difference	LARGE SAMPLE TEST OF SIG. Direction of Change Period 1 vs Period 3	Overall Conclusion	Support for Research Hypothesis
HYPOTHESES RELATING TO QUALITY OF MAINTENANCE						
7	Ground Abort Rate	No	No	Decrease	Inconclusive results	No
8	Air Abort Rate	Yes	Yes	Decrease	POMO appears to have improved performance	Yes
9	Code-3 Break Rate	Yes	Yes	Decrease	POMO appears to have improved performance	Yes
10	Cannibalization Rate	No	No	Increase	Inconclusive results	No

variable constantly decreased throughout the data base period and seemingly indicated degraded productivity due to POMO. Further investigation, however, revealed that the greatest factor contributing to the lower FMC Rate was actually a parts supply problem which rendered aircraft only Partial Mission-Capable, Supply (PMCS).

It should be recognized here that the PMCM Rate also increased under POMO, even though this increase was slight in comparison to the higher PMCS Rate. A possible cause for the higher PMCM Rate may have been due to increased emphasis on sortie production with POMO. Perhaps maintenance decision makers were more likely to allow a PMCM aircraft to fly rather than to complete its repair and upgrade its status to FMC.

Hypothesis 2

POMO will decrease Average Turnaround Times. The research did not support this hypothesis. These results infer that assigning specialists to the AGS flightline and lowering decision making to unit production levels did not speed up the aircraft turnaround process.

Hypothesis 3

POMO will decrease NMCM-U Rates. The research test results were inconclusive and therefore did not support this hypothesis. Pre-POMO through post-post-POMO NMCM-U Rates showed no statistically significant change.

This indicates that little change occurred in the average time that ADTAC aircraft underwent maintenance for unexpected grounding conditions.

Hypothesis 4

POMO will decrease NMCM-S Rates. The research did support this hypothesis. Less time, on the average, was spent performing maintenance on aircraft with anticipated grounding conditions. The bulk of NMCM-S time is generally used during routine scheduled inspections. Inspections of shorter duration are performed by AGS on the flightline, while EMS is responsible for the longer phase inspections. These findings may indicate that cross-utilization training has paid off in manpower efficiencies during the inspection process.

Hypothesis 5

Aircraft Scheduling Effectiveness will increase. The research did support this hypothesis. With POMO, more ADTAC aircraft flew their scheduled sorties at the proper times. These results infer that ADTAC maintenance under POMO placed a higher emphasis on adhering to the daily flying schedule. Perhaps the quicker AGS decision making and specialist dispatch capabilities saved many sorties which would have been late or cancelled otherwise.

Hypothesis 6

Man-hours per Flying Hour will decrease. The research did not support this hypothesis due to inconclusive test results. Implementing POMO has had no appreciable impact on this productivity indicator. The POMO concept did not bring about the expected efficiencies in maintenance manpower due to cross-utilization training.

Quality

The research also provided mixed results for POMO's effect on maintenance quality. Two of the four research hypotheses investigating maintenance quality showed marked improvements (Table 5). Specifically, these improvements were in the areas of Air Abort Rates and Code-3 Break Rates. Ground Abort Rates and Cannibalization Rates remained unaffected.

Hypothesis 7

Ground Abort Rates will decrease. The research test results were inconclusive and did not support this hypothesis. Apparently, those maintenance problems which normally cause an aircraft to Ground Abort were not prevented by adopting the POMO philosophy.

Hypothesis 8

Air Abort Rates will decrease. The research results did support this hypothesis. Under the POMO

concept, once an aircraft became airborne, there was greater probability that it would complete its mission.

Hypothesis 9

POMO will reduce Code-3 Break Rates. The research did support this hypothesis. Serious maintenance problems which ground an aircraft following a Sortie decreased under POMO. Improved maintenance quality in general would contribute to such a decrease.

Hypothesis 10

Cannibalization Rates will decrease. The research did not support this hypothesis. The Cannibalization Rate variable provided no conclusive evidence for either advocating or rejecting the theory that POMO improves maintenance quality.

Overall Conclusion

Based on the results of this research effort, POMO in ADTAC has met with only a limited degree of success in improving maintenance productivity and quality over the long run. The POMO concept has at least maintained the pre-POMO status quo and has at best slightly improved those earlier levels of maintenance achievement under the traditional maintenance concept.

Implications for Management

The degree that these research results are generalizable to other tactical fighter units is largely unknown. However, POMO's common thread of organizational decentralization runs throughout all aircraft maintenance currently performed under AFR 66-5. A key objective of the concept was to lower decision making to the production level, thereby affording line managers greater flexibility and freedom. The authors suggest that such lower level decision making may be somewhat more effective than was the AFR 66-1 structure.

Another essential ingredient of the POMO doctrine was to permanently station various critical maintenance specialists on the AGS flightline. With the resulting immediate dispatch capability, specialists were to help reduce aircraft turnaround times and time spent repairing unscheduled maintenance problems. The research results indicated no significant improvement in these two maintenance activities.

In a forerunner to this study, Foster and Olson recorded similar overall findings, ". . . POMO appears to have little positive effect on aircraft maintenance [4:108]." They concluded that POMO showed no overwhelming improvement for one of two reasons. First, perhaps the true POMO organization had not been fully incorporated by the time their study was conducted in 1978. Therefore,

all of POMO's benefits could not be realized until the concept had been better tested by time. Second, POMO simply may not be as effective as its designers had hoped. In either case, the less than expected level of performance for the long run under POMO bears striking similarities to Foster and Olson's conclusions. For whatever reason, then, the POMO concept's lukewarm impact on ADTAC aircraft maintenance has shown little change after meeting the test of time.

This is not to say that POMO has not been the success its proponents claimed it would be. Two important areas concerning the implementation of POMO need further discussion and consideration in this section.

First, it is possible that the POMO reorganization of the maintenance complex is not the best method for improving maintenance productivity and quality. For example, one particular major command using a form of POMO believes that manpower is a prime determinant of productivity. Plans have been made to increase aircraft maintenance manning in this command's tactical fighter wings solely to yield higher productivity. More details of these plans will be discussed in the Future Research section of this chapter. Perhaps other variables would also contribute more to changes in productivity and quality than does organizational change under the POMO concept. Examining such variables was outside the scope of this particular

study, but remains an important consideration for later research.

Second, the POMO concept may be better suited for deployments, detachments, or forward operating bases (FOBs) than for the wing structure. It is possible that POMO reorganization at the wing level is justified for wings that regularly deploy or operate from FOBs. This is certainly a question that could be researched in the future.

Recommendations

POMO is a useful maintenance concept for the U.S. Air Force. This study indicates that maintenance productivity and quality met, and in some areas exceeded, those levels achieved under the traditional AFR 66-1 organization. The time is right for management to begin positively identifying weak areas of POMO whether they be organizational or behavioral in nature. Next, base level brainstorming sessions and testing new variations of POMO should be encouraged and guided from the major command level. POMO has proved itself to be a useful organizational concept for maintenance managers. It should not be discarded as a failure simply because the projected increases in productivity and quality did not fully materialize. Rather, POMO should be modified and improved in a careful iterative process involving all levels of maintenance management. Only in this way can we insure that full advantage of the POMO concept is realized.

Future Research

Before presenting recommendations for areas of future research, it is important to note that POMO is still in the process of evolution and change. During the latter stages of this study it was brought to the attention of the researchers that manning authorizations for TAF maintenance organizations will be changing. Headquarters TAC pointed out that starting in fiscal year 1983 the ADTAC FISs will increase in maintenance authorizations by 30 personnel and TAF wings will increase by 90 to 100 personnel. This is important for further research because of the impact it should have on POMO organizations.

This research effort quantitatively analyzed POMO's long-term impact on five ADTAC F-106 FISs. However, many questions concerning this maintenance concept remain unanswered and warrant additional investigation. The following areas should be seriously considered for future research topics.

Other Major Commands

POMO's performance in ADTAC may be indicative of its impact in other major commands under AFR 66-5 guidance. However, differences in operational missions, in aircraft types, or even in definitions for maintenance terms among the commands may complicate many otherwise clear

comparisons with ADTAC. Therefore, POMO's impact could be more accurately measured by developing a separate research methodology for each target command. Many units within these other commands have recently been assigned new fighter aircraft such as the F-15, F-16, or A-10. Thus, insufficient historical maintenance data may prevent long-term POMO research at some of these bases. Regardless of the length of periods analyzed, valuable insight to POMO will be gained by examining its performance within other major commands.

Behavioral Impact

Only a limited amount of research has been documented concerning the effect POMO has had on the maintenance personnel who must work under it. Research is needed on POMO's impact in such behavioral areas as job satisfaction, work environment, motivation and promotion opportunities. A more comprehensive estimation of POMO's worth can be made if these qualitative findings are considered along with the quantitative type research presented in this study.

For example, specific studies should be undertaken to determine POMO's effect on retention and morale. These studies could include areas such as identification with the mission, cross-utilization training, "unionization" of specialists, experience levels, promotion opportunities,

and overall general attitudes of personnel concerning the POMO concept. Based on present increases in TAF manning authorizations for POMO units, a separate study could examine manpower and productivity relationships.

POMO and Deployments

A main goal of POMO not tested in this study is its ability to increase deployment effectiveness. Studies ought to be initiated to determine whether or not deployments are actually enhanced under the POMO concept. Questions which could be addressed include: are the Aircraft Maintenance Units (AMU) mutually autonomous, can a wing of four squadrons actually deploy to four different locations, are supply channels sufficient to support an entire wing of three or four squadrons to three or four different locations, does sortie generation capability increase or decrease as compared to home base exercises, and finally, can individual AMUs and tactical fighter squadrons be supported in wartime conditions; and if so, for how long with present resources?

Cost Analysis of the Implementation of POMO

Another primary goal of POMO is increasing productivity while reducing costs (12:p.1-1). Future research is needed to determine if POMO has been successful in accomplishing this goal. In today's era of increased

costs and debates on military spending this area of study becomes highly important. Implementation of new concepts should be cost-effective as well as mission-effective. Finally, the long-term costs of POMO also deserve future research.

POMO versus Civilian Production and Maintenance

This area of study could concentrate on comparing the POMO concept of decentralization of decision making with its counterparts in civilian business and industry. The research could compare and contrast POMO with the civilian airline industry to determine possible alternatives to USAF aircraft maintenance.

Particular Weapons Systems and Missions

The possibility exists that the POMO concept is more compatible with certain types of weapons systems performing specific operational missions. For instance, perhaps the new TAC ground attack mission for the F-15 will be even better served by POMO than is its air defense mission in ADTAC. Complex design features unique to a particular fighter may render POMO less effective than those of a less complicated aircraft. This type of research would involve many comparative studies of both aircraft and missions found in the POMO arena.

Other Services

In an effort to improve POMO's contributions, aircraft maintenance practices in the sister services should be evaluated for possible U.S. Air Force applications. For example, it might be advantageous to compare POMO to the Navy's aircraft maintenance concept. Additional maintenance lessons may be learned from international sources. Two prominent examples are the British air battles over the Falkland Islands and the Israeli successes against the Syrian air forces over Lebanon.

APPENDICES

APPENDIX A

RESEARCH DATA

MINOT

PRE-POMO PERIOD 1--JANUARY-DECEMBER 1977

FMC	ATT	NMCM-U	NMCM-S	SE	MXMN	GABR	AABR	CD3	CAN
65.8	-	17.4	13.8	-	-	-	-	-	-
69.7	7.2	10.8	14.9	73.3	-	0.5	0.0	30.2	7.0
60.0	6.0	12.8	9.5	67.8	-	1.9	0.0	32.7	6.6
71.2	8.3	14.2	8.5	63.4	-	3.2	0.4	37.9	7.7
75.1	8.0	13.8	8.9	66.1	-	5.1	0.8	33.0	2.4
67.0	8.7	-	-	66.4	-	1.7	0.8	35.8	6.3
62.7	8.2	-	-	79.1	-	3.7	0.4	43.0	8.0
62.7	8.3	16.8	9.5	82.7	-	0.8	1.4	48.7	12.0
62.4	10.1	18.6	8.7	78.7	-	1.6	0.4	35.0	11.0
70.0	11.5	2.0	5.9	69.1	-	5.4	1.8	54.8	10.3
49.2	11.0	23.0	7.1	50.6	-	8.2	0.5	52.4	14.5
51.4	8.2	15.1	4.4	63.4	-	8.0	1.9	52.0	10.9

FMC -- FMC Rate
ATT -- Average Turn Time
NMCM-U -- NMCM-U Rate
NMCM-S -- NMCM-S Rate
SE -- Scheduling Effectiveness
MXNM -- Maintenance Man-hours per Flying Hour
GABR -- Ground Abort Rate
AABR -- Air Abort Rate
CD3 -- Code-3 Break Rate
CAN -- Cannibalization Rate

MINOT

POST-POMO PERIOD 2--JANUARY-DECEMBER 1979

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
72.5	-	8.7	2.4	-	-	-	-	-	-
65.4	5.7	8.2	3.2	45.2	-	4.3	1.4	39.7	13.8
49.9	5.9	8.4	2.1	68.0	-	3.8	2.6	39.7	12.9
69.9	4.8	7.0	3.1	72.0	-	1.1	1.1	40.5	20.6
65.7	3.9	6.8	7.4	77.5	-	0.6	0.6	29.9	10.2
70.7	4.8	-	-	71.9	-	3.7	1.7	34.9	6.2
67.4	7.0	-	-	87.7	-	0.7	0.0	27.0	8.4
72.1	4.8	7.0	1.0	65.6	-	2.9	1.1	33.7	7.4
69.4	6.3	8.4	0.2	61.2	-	0.8	0.4	27.9	8.4
63.3	4.1	6.3	4.9	64.1	-	0.7	0.0	31.0	3.3
59.6	4.8	11.6	3.3	74.1	-	1.8	1.1	32.1	15.0
57.3	5.5	12.3	3.7	72.2	-	4.8	0.5	38.4	14.5

MINOT

POST-POST-POMO PERIOD 3--JANUARY-DECEMBER 1981

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
58.2	-	6.9	3.1	-	-	-	-	-	-
53.6	9.7	6.9	5.3	90.2	-	1.7	0.9	31.5	8.8
53.2	8.2	9.4	7.9	85.5	-	1.8	0.4	27.7	8.9
57.2	5.6	10.0	1.0	91.4	-	1.6	1.3	27.0	7.6
51.4	10.5	6.8	3.3	92.3	-	1.1	0.0	30.0	8.2
43.5	11.6	-	-	84.8	-	0.7	1.5	31.1	11.5
42.2	9.0	-	-	80.9	-	0.3	1.0	33.8	11.9
58.2	10.4	6.4	1.7	87.8	-	0.7	0.0	25.1	9.3
54.7	9.2	9.0	8.0	80.1	-	4.3	1.3	29.1	3.7
66.9	9.7	12.3	5.9	80.0	-	3.6	0.7	35.6	2.6
69.7	14.3	10.6	6.0	86.1	-	1.6	0.0	22.0	2.3
61.1	13.5	13.9	2.5	71.2	-	1.6	0.0	22.9	1.6

LANGLEY

PRE-POMO PERIOD 1--JANUARY-DECEMBER 1977

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
64.2	-	20.2	9.4	-	35.3	-	-	-	-
58.3	9.0	21.2	8.2	67.1	35.0	3.2	0.0	39.8	7.4
65.5	21.6	19.9	7.6	82.2	46.7	3.8	0.8	32.4	1.8
62.6	14.3	23.5	5.8	90.3	44.5	0.8	0.0	35.2	0.0
59.6	11.4	26.7	9.7	79.8	51.3	1.6	0.4	41.8	2.6
61.1	11.5	-	-	74.2	47.2	4.2	0.9	47.3	6.3
69.0	8.4	-	-	85.7	33.0	2.5	0.7	44.3	3.3
69.1	8.5	16.0	9.4	92.9	33.3	2.0	0.7	35.6	5.1
62.0	11.0	21.0	9.5	77.4	38.3	3.6	1.4	52.0	5.4
70.5	10.5	17.2	2.3	84.5	41.7	2.7	2.0	40.0	5.3
79.2	9.5	12.9	4.8	66.0	52.9	5.3	2.0	52.2	7.4
58.4	11.0	14.8	10.5	74.1	44.9	2.9	2.1	45.6	2.9

FMC -- FMC Rate
ATT -- Average Turn Time
NMCM-U -- NMCM-U Rate
NMCM-S -- NMCM-S Rate
SE -- Scheduling Effectiveness
MXNM -- Maintenance Man-hours per Flying Hour
GABR -- Ground Abort Rate
AABR -- Air Abort Rate
CD3 -- Code-3 Break Rate
CAN -- Cannibalization Rate

LANGLEY

POST-POMO PERIOD 2--JANUARY-DECEMBER 1979

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
38.2	-	15.5	3.8	-	60.0	-	-	-	-
48.0	6.4	18.6	7.1	81.2	53.1	1.5	0.9	22.9	6.6
48.1	9.6	19.0	4.6	79.8	62.4	2.5	0.4	47.5	16.4
43.1	9.3	11.7	3.2	92.3	48.1	3.1	1.1	45.5	13.4
42.9	8.5	10.4	2.4	86.1	47.8	1.7	0.3	44.0	10.6
55.0	9.7	-	-	77.1	59.5	0.8	1.2	47.2	4.1
55.2	8.5	-	-	86.2	48.0	3.3	2.0	54.8	5.4
42.3	6.3	10.2	2.1	76.6	51.3	4.3	1.4	37.8	8.4
43.8	8.8	10.8	1.4	70.7	60.4	4.2	0.9	44.7	13.2
31.9	8.1	10.2	6.0	80.9	56.6	2.9	0.7	50.5	7.8
29.0	9.4	13.6	3.6	63.2	47.9	3.3	0.3	38.3	8.8
27.1	12.2	15.8	3.8	79.5	54.4	3.7	0.0	42.0	6.0

LANGLEY

POST-POST-POMO PERIOD 3--JANUARY-DECEMBER 1981

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
35.0	-	14.0	6.6	-	57.5	-	-	-	-
36.5	11.4	17.3	4.7	77.3	68.0	2.4	2.0	43.3	17.1
40.5	8.9	13.0	4.1	80.8	50.3	2.3	0.7	35.4	17.1
41.0	12.4	17.6	4.2	77.3	50.3	3.2	0.4	37.3	14.3
42.9	13.6	15.3	3.2	84.7	58.6	2.1	0.7	29.4	9.9
44.1	10.3	-	-	86.6	43.0	2.4	0.9	33.3	14.6
18.3	14.6	-	-	61.9	62.5	5.8	0.8	38.8	25.1
43.8	14.0	15.2	0.1	74.4	45.5	4.9	1.3	38.5	18.0
49.5	15.1	13.8	3.5	72.9	49.3	1.8	0.5	40.0	11.9
56.6	14.9	13.5	2.6	75.3	55.1	2.3	0.9	43.8	19.7
40.4	11.0	15.3	0.1	61.8	65.1	2.2	1.0	39.8	23.0
60.5	11.5	14.5	1.6	89.1	76.7	1.7	0.6	43.7	11.4

GRIFFISS

PRE-POMO PERIOD 1--JANUARY-DECEMBER 1977

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
49.8	-	25.9	11.2	-	48.1	-	-	-	-
45.1	8.6	19.4	9.9	88.3	46.6	1.6	1.6	48.2	5.2
41.1	23.4	18.3	16.3	75.5	70.9	1.4	0.0	46.3	6.2
70.0	10.6	11.8	16.5	89.2	43.4	0.8	0.4	41.4	3.5
64.3	8.7	10.9	15.1	77.7	39.2	1.9	0.4	35.9	3.4
61.1	7.7	-	-	77.1	44.5	2.8	0.4	38.5	4.7
67.9	8.8	-	-	81.1	35.4	3.2	0.8	54.2	4.8
73.1	9.5	13.8	3.8	77.7	34.0	2.4	0.0	41.7	1.2
64.2	8.4	14.9	10.1	74.2	32.2	2.6	0.4	41.7	3.5
67.1	9.0	7.0	15.1	65.5	22.8	1.3	0.7	41.6	1.4
59.2	14.4	19.0	9.7	68.9	33.8	4.8	0.4	48.4	2.8
60.2	10.0	15.9	7.8	54.9	38.2	3.6	0.5	47.3	1.0

FMC -- FMC Rate
ATT -- Average Turn Time
NMCM-U -- NMCM-U Rate
NMCM-S -- NMCM-S Rate
SE -- Scheduling Effectiveness
MXNM -- Maintenance Man-hours per Flying Hour
GABR -- Ground Abort Rate
AABR -- Air Abort Rate
CD3 -- Code-3 Break Rate
CAN -- Cannibalization Rate

GRIFFISS

POST-POMO PERIOD 2--JANUARY-DECEMBER 1979

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
61.7	-	15.6	1.6	-	34.2	-	-	-	-
47.2	9.0	19.1	11.2	78.8	61.8	2.4	1.0	58.0	5.2
59.7	10.1	16.5	4.0	79.3	47.1	0.8	0.4	44.1	6.2
54.1	9.6	17.7	5.6	84.5	34.1	2.5	1.1	41.2	9.1
61.5	8.5	11.5	7.8	69.4	38.5	1.9	1.2	37.9	3.3
63.0	7.5	-	-	89.5	30.8	4.1	1.3	35.7	4.1
60.5	6.3	-	-	85.7	37.3	2.4	3.8	44.9	4.9
42.0	6.9	18.0	4.9	80.6	25.8	2.3	1.7	52.1	4.7
37.3	6.2	26.4	4.1	78.5	44.8	0.8	1.7	45.8	4.7
55.3	11.8	13.8	2.9	79.5	43.9	2.5	1.1	51.3	7.4
53.4	15.7	18.4	3.1	76.2	25.0	1.4	1.4	36.2	3.5
53.9	7.5	16.5	2.5	74.1	38.6	2.2	1.1	47.1	4.5

GRIFFISS

POST-POST-POMO PERIOD 3--JANUARY-DECEMBER 1981

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
52.2	-	19.1	1.9	-	56.4	-	-	-	-
55.9	6.7	27.2	7.0	70.0	55.9	0.8	0.0	31.9	7.9
54.1	6.3	27.2	5.2	77.7	46.9	1.8	1.2	33.1	3.9
55.5	5.5	19.6	6.6	79.7	42.2	1.3	1.0	29.0	2.3
66.4	6.4	18.3	2.4	73.6	45.7	3.2	0.0	32.7	2.9
56.0	9.3	-	-	75.9	42.5	5.5	0.3	30.5	4.2
49.3	11.4	-	-	74.2	41.2	2.7	0.0	16.3	0.8
62.5	7.1	13.6	3.8	85.8	21.9	1.9	0.0	17.9	1.9
68.3	7.1	15.3	6.5	88.1	45.0	3.1	0.9	35.4	1.4
64.1	13.2	17.2	3.0	75.3	41.9	2.6	0.4	24.5	2.3
53.7	12.2	26.5	5.2	72.2	28.9	2.9	0.7	35.6	0.4
35.6	10.0	18.4	1.8	79.5	46.3	4.1	0.4	28.6	2.6

K. I. SAWYER

PRE-POMO PERIOD 1--JANUARY-DECEMBER 1977

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
52.1	-	26.1	11.0	-	40.2	-	-	-	-
56.1	11.0	20.1	12.4	74.9	36.4	0.4	1.3	20.5	12.4
61.8	20.3	18.6	8.1	57.0	47.6	4.5	1.4	29.0	10.8
69.6	11.9	19.7	4.2	75.1	41.7	5.1	0.9	30.4	5.8
61.1	18.8	19.0	9.5	71.3	45.3	3.0	0.4	28.4	8.8
62.7	17.3	-	-	77.0	43.9	4.5	1.7	33.8	6.4
66.3	16.2	-	-	78.3	36.8	3.0	0.0	22.8	11.8
61.4	11.6	15.7	8.1	75.5	43.8	3.0	0.7	29.0	3.7
78.2	8.6	12.4	7.6	74.9	44.2	3.4	0.4	26.9	1.5
69.5	10.3	2.4	11.1	81.0	41.8	3.6	1.9	32.5	4.0
58.1	11.7	14.8	2.9	45.3	52.0	4.7	2.1	35.7	5.4
56.5	12.4	13.3	3.5	61.5	37.2	6.6	0.5	27.1	4.3

FMC -- FMC Rate
ATT -- Average Turn Time
NMCM-U -- NMCM-U Rate
NMCM-S -- NMCM-S Rate
SE -- Scheduling Effectiveness
MXNM -- Maintenance Man-hours per Flying Hour
GABR -- Ground Abort Rate
AABR -- Air Abort Rate
CD3 -- Code-3 Break Rate
CAN -- Cannibalization Rate

K. I. SAWYER

POST-POMO PERIOD 2--JANUARY-DECEMBER 1979

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
65.2	-	14.0	1.7	-	55.2	-	-	-	-
50.4	9.3	22.0	1.4	83.3	44.9	2.2	0.5	38.8	5.0
63.5	7.9	12.0	4.8	88.2	42.9	3.7	1.9	42.2	8.9
67.3	6.5	7.6	3.6	93.1	40.1	2.6	2.3	31.3	8.5
67.9	5.8	8.6	2.5	92.1	43.7	0.7	1.1	36.7	6.0
67.4	7.4	-	-	89.4	45.8	1.0	0.5	32.0	2.7
61.5	8.3	-	-	97.1	38.8	9.2	1.3	41.5	2.5
46.3	8.1	14.9	1.5	92.9	37.2	5.5	1.7	42.9	4.4
54.3	6.8	9.2	[illegible]	87.3	42.0	3.5	1.2	39.4	5.6
53.7	7.4	10.2	0.[illegible]	87.5	44.0	3.8	0.3	34.2	8.6
53.0	7.2	8.4	1.0	87.0	46.3	3.8	1.4	40.8	9.6
55.8	7.8	9.4	0.8	79.0	39.9	4.3	1.1	40.9	7.1

K. I. SAWYER

POST-POST-POMO PERIOD 3--JANUARY-DECEMBER 1981

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
38.9	-	23.2	4.0	-	56.3	-	-	-	-
33.8	9.9	17.0	4.4	79.5	40.4	1.2	0.4	32.2	9.7
34.6	9.6	14.9	5.9	73.8	42.2	3.2	0.4	38.4	11.1
35.2	9.0	15.3	4.8	86.6	30.7	2.7	0.3	42.7	6.5
38.9	10.5	15.6	9.0	86.5	33.9	2.0	0.9	37.0	8.7
32.5	12.8	-	-	77.0	34.2	2.3	1.2	36.6	6.8
26.0	7.6	-	-	76.4	36.3	3.5	0.0	36.8	5.3
34.7	9.6	18.1	2.7	85.2	31.4	1.5	0.6	30.7	5.0
62.0	8.8	17.4	3.1	83.5	36.3	0.4	0.0	35.4	8.0
65.6	10.1	19.7	2.1	76.2	34.0	1.7	0.0	30.1	4.3
17.3	27.8	26.8	0.8	61.9	43.8	5.0	0.0	32.4	3.9
25.7	17.2	25.8	1.2	84.1	35.8	3.7	1.1	29.4	5.6

AD-A123 981 THE EFFECTS OF THE PRODUCTION ORIENTED MAINTENANCE ORGANIZATION (POMO) CO..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. 2/2

UNCLASSIFIED J B AMEND ET AL. SEP 82 AFIT-LSSR-70-82 F/G 1/3 NL

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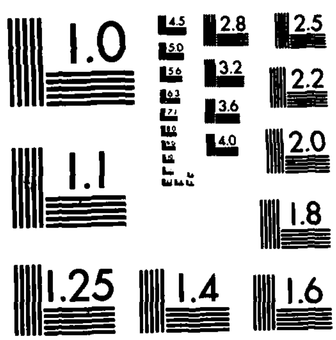

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

McCHORD

PRE-POMO PERIOD 1--JANUARY-DECEMBER 1977

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
66.3	-	14.1	14.2	-	-	-	-	-	-
67.8	9.2	17.7	10.4	60.1	-	5.0	1.7	27.4	7.8
65.1	7.1	14.6	10.2	73.5	-	3.2	3.7	23.7	7.7
71.3	6.8	15.9	8.8	57.3	-	3.3	1.0	17.9	7.7
78.2	4.1	8.7	7.3	75.8	-	0.8	0.4	21.5	3.2
64.7	6.5	-	-	62.2	-	1.4	0.7	23.3	8.7
70.3	6.7	-	-	61.1	-	2.2	0.7	22.8	7.6
59.2	8.0	21.4	7.6	65.8	-	8.2	1.4	32.5	4.7
57.8	8.1	17.8	15.2	60.8	-	3.4	0.8	29.6	10.7
67.5	6.0	6.4	13.7	74.2	-	2.4	1.9	30.0	3.8
71.4	8.8	14.1	4.3	67.3	-	1.8	2.3	24.7	3.2
60.7	10.6	19.6	3.8	62.6	-	4.3	0.0	21.3	13.3

FMC -- FMC Rate
ATT -- Average Turn Time
NMCM-U -- NMCM-U Rate
NMCM-S -- NMCM-S Rate
SE -- Scheduling Effectiveness
MXNM -- Maintenance Man-hours per Flying Hour
GABR -- Ground Abort Rate
AABR -- Air Abort Rate
CD3 -- Code-3 Break Rate
CAN -- Cannibalization Rate

McCHORD

POST-POMO PERIOD 2--JANUARY-DECEMBER 1979

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
50.4	-	2.7	1.4	-	-	-	-	-	-
44.0	16.3	4.4	0.1	79.1	-	6.8	2.7	47.7	7.3
62.9	10.9	3.4	0.9	91.4	-	2.6	1.6	43.0	5.0
50.5	12.0	6.3	6.0	87.6	-	5.4	0.8	46.0	15.7
62.6	9.8	6.1	3.4	83.7	-	2.0	0.9	29.0	6.7
38.2	11.6	-	-	90.8	-	3.9	0.3	32.6	3.0
51.2	13.1	-	-	73.1	-	4.4	2.8	37.2	5.7
57.7	11.0	7.4	0.1	76.0	-	2.3	0.0	33.1	4.1
74.8	8.5	6.7	3.3	79.2	-	4.7	0.4	39.1	5.3
51.4	11.4	9.3	4.3	73.1	-	4.8	0.7	28.4	4.0
53.1	11.3	10.4	1.0	66.7	-	3.9	1.8	33.9	7.2
58.7	11.1	10.0	2.7	61.6	-	2.7	1.6	33.3	4.1

McCHORD

POST-POST-POMO PERIOD 3--JANUARY-DECEMBER 1981

FMC	ATT	NMCM-U	NMCM-S	SE	MXNM	GABR	AABR	CD3	CAN
55.6	-	8.2	2.9	-	-	-	-	-	-
35.1	10.5	16.6	1.8	81.7	-	1.9	0.0	16.3	3.9
37.3	12.5	18.8	4.0	78.2	-	3.7	0.0	40.9	9.1
44.6	19.8	15.7	1.9	86.5	-	1.5	0.0	25.1	7.7
50.7	13.7	21.4	1.3	70.9	-	3.5	0.7	30.6	4.4
55.9	10.2	-	-	70.7	-	5.9	0.7	29.3	2.0
51.6	13.0	-	-	61.8	-	7.4	0.8	37.9	2.5
52.6	8.4	19.7	6.3	64.6	-	2.3	0.4	27.8	1.9
58.5	8.9	18.7	5.3	80.9	-	0.1	0.7	26.0	3.4
53.6	13.7	21.2	3.5	66.0	-	4.3	0.8	31.0	10.4
41.3	12.6	23.4	2.1	67.2	-	4.5	0.0	24.2	4.9
13.0	11.2	24.5	5.9	71.6	-	5.3	0.5	38.2	3.0

APPENDIX B

COMPUTER TEST RESULTS

ANALYSIS OF VARIANCE--HYPOTHESIS 1 15 JUL 82 10:06:53 PAGE 3
COMPARISON OF FMC RATES DATA PERIOD 1,2,3
FILE NONAME (CREATED 15 JUL 82 10:06:53)

- O N E W A Y -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	7961.1934	3980.5967	33.870	0.0000
WITHIN GROUPS	177	20802.2098	117.5266		
TOTAL	179	28763.4033			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	60	63.7350	7.5741	0.9778	41.1000	79.2000	61.7784 TO 65.6916
GRP02	60	54.9867	11.0987	1.4328	27.1000	74.8000	52.1196 TO 57.8538
GRP03	60	47.4600	13.1160	1.6933	13.0000	69.7000	44.0718 TO 50.8482
TOTAL	180	55.3939	12.6763	0.9448	13.0000	79.2000	53.5294 TO 57.2583
FIXED EFFECTS MODEL			10.8410	0.8080			53.7993 TO 56.9885
RANDOM EFFECTS MODEL				4.7026			35.1600 TO 75.6278

```
ANALYSIS OF VARIANCE--HYPOTHESIS I                                15 JUL 82 10:06:53        PAGE    4
COMPARISON OF TAC RATES DATA PERIOD 1,2,3
FILE      NONAME (CREATED  15 JUL 82 10:06:53)

- - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - -

     VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
        7.6657 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)


SUBSET  1

GROUP       GRP03
MEAN       47.4600
- - - - - - - - - -

SUBSET  2

GROUP       GRP02
MEAN       54.9667
- - - - - - - - - -

SUBSET  3

GROUP       GRP01
MEAN       63.7350
- - - -     - - - -
```

ANALYSIS OF VARIANCE--HYPOTHESIS 1A　　　8 JUL 82 14:29:28　　　PAGE 3
COMPARISON OF FM&PMC DATA PERIOD 1,2,3
FILE　NONAME (CREATED 8 JUL 82 14:29:28)

- O N E W A Y -

VARIABLE　D　DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	1819.6943	909.8472	25.657	0.0000
WITHIN GROUPS	177	6276.7752	35.4620		
TOTAL	179	8096.4695			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	60	68.5833	6.2202	0.8030	54.6000	81.4000	66.9765 TO 70.1902
GRP02	60	74.6050	5.9974	0.7743	57.6000	89.5000	73.0557 TO 76.1543
GRP03	60	67.3167	5.6326	0.7272	56.0000	77.9000	65.8616 TO 68.7717
TOTAL	180	70.1683	6.7254	0.5013	54.6000	89.5000	69.1791 TO 71.1575
FIXED EFFECTS MODEL			5.9550	0.4439			69.2924 TO 71.0443
RANDOM EFFECTS MODEL				2.2483			60.4947 TO 79.8420

```
ANALYSIS OF VARIANCE--HYPOTHESIS 1A                                          8 JUL 82 14:29:28      PAGE    4
COMPARISON OF FM&PMC DATA PERIOD 1,2,3
FILE      NONAME (CREATED   8 JUL 82 14:29:28)

- - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - -


      VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
       4.2108 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)

SUBSET  1

GROUP       GRP03       GRP01
MEAN       67.3167     68.5833
- - - - - - - - - - - - - - - - -

SUBSET  2

GROUP       GRP02
MEAN       74.6050
- - - - - - - - - - -


ANALYSIS OF VARIANCE--HYPOTHESIS 1A                                          8 JUL 82 14:29:28      PAGE    5
```

ANALYSIS OF VARIANCE--HYPOTHESIS 1B 8 JUL 82 14:44:32 PAGE 3
COMPARISON OF PMLS DATA PERIOD 1,2,3
FILE NONAME (CREATED 8 JUL 82 14:44:32)

- O N E W A Y -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	5426.5770	2713.2885	39.308	0.0000
WITHIN GROUPS	177	12217.8005	69.0271		
TOTAL	179	17644.3775			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	60	3.1100	2.3255	0.3002	0.0000	13.2000	2.5093 TO 3.7107
GRP02	60	14.7650	9.8432	1.2707	0.8000	35.9000	12.2222 TO 17.3078
GRP03	60	14.7500	10.2365	1.3215	1.2000	42.1000	12.1056 TO 17.3944
TOTAL	180	10.8750	9.9283	0.7400	0.0000	42.1000	9.4147 TO 12.3353
	FIXED EFFECTS MODEL		8.3083	0.6193			9.6529 TO 12.0971
	RANDOM EFFECTS MODEL			3.8825			-5.8302 TO 27.5802

```
ANALYSIS OF VARIANCE--HYPOTHESIS 1B                                    8 JUL 82 14:44:32        PAGE    4
COMPARISON OF PMCS DATA PERIOD 1,2,3
FILE     NONAME (CREATED   8 JUL 82 14:44:32)

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     VARIABLE    D        DATA

MULTIPLE RANGE TEST

DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
       5.8748 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)

SUBSET  1

GROUP       GRP01
MEAN        3.1100
- - - - - - - - - -

SUBSET  2

GROUP       GRP03         GRP02
MEAN       14.7500       14.7650
- - - - - - - - - - - - - - - - -

ANALYSIS OF VARIANCE--HYPOTHESIS 1B                                    8 JUL 82 14:44:32        PAGE    5
COMPARISON OF PMCS DATA PERIOD 1,2,3
```

ANALYSIS OF VARIANCE--HYPOTHESIS 2 8 JUL 82 14:56:44 PAGE 3
COMPARISON OF ATT DATA PERIOD 1,2,3
FILE NONAME (CREATED 8 JUL 82 14:56:44)

- O N E W A Y -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	292.5448	146.2724	11.686	0.0000
WITHIN GROUPS	177	2215.4117	12.5165		
TOTAL	179	2507.9564			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	60	10.4750	3.8216	0.4934	4.1000	23.4000	9.4878 TO 11.4622
GRP02	60	8.5133	2.7551	0.3557	3.9000	16.3000	7.8016 TO 9.2250
GRP03	60	11.5983	3.9185	0.5059	5.5000	27.8000	10.5861 TO 12.6106
TOTAL	180	10.1956	3.7431	0.2790	3.9000	27.8000	9.6450 TO 10.7461
	FIXED EFFECTS MODEL		3.5379	0.2637			9.6752 TO 10.7159
	RANDOM EFFECTS MODEL			0.9015			6.3169 TO 14.0743

ANALYSIS OF VARIANCE--HYPOTHESIS 1C　　22 JUL 82 12:16:01　　PAGE 3
COMPARISON OF PMCM RATES DATA PERIOD 1,2,3
FILE　NONAME (CREATED 22 JUL 82 12:16:01)

- O N E W A Y -

VARIABLE　D　　DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	978.7768	489.3884	26.206	0.0000
WITHIN GROUPS	177	3305.4785	18.6750		
TOTAL	179	4284.2553			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	60	1.4283	1.8561	0.2396	0.0000	8.8000	0.9489 TO 1.9078
GRP02	60	7.1267	6.2790	0.8106	0.0000	25.5000	5.5046 TO 8.7487
GRP03	60	3.9367	3.6268	0.4682	0.0000	16.5000	2.9998 TO 4.8736
TOTAL	180	4.1639	4.8923	0.3646	0.0000	25.5000	3.4443 TO 4.8835
FIXED EFFECTS MODEL			4.3215	0.3221			3.5282 TO 4.7995

```
ANALYSIS OF VARIANCE--HYPOTHESIS 1C                                            22 JUL 82 12:16:01        PAGE    4
COMPARISON OF FMCM RATES DATA PERIOD 1,2,3
FILE      NONAME (CREATED  22 JUL 82 12:16:01)

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      VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
        3.0557 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)


SUBSET  1

GROUP       GRP01
MEAN        1.4283
- - - - - - - - - -

SUBSET  2

GROUP       GRP03
MEAN        3.9367
- - - - - - - - - -

SUBSET  3

GROUP       GRP02
MEAN        7.1267
```

```
ANALYSIS OF VARIANCE--HYPOTHESIS 2                                        8 JUL 82 14:56:44       PAGE    4
COMPARISON OF ATT DATA PERIOD 1,2,3
FILE     NONAME (CREATED   8 JUL 82 14:56:44)

- - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - - - -

     VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
        2.5016 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)

SUBSET  1

GROUP       GRP02
MEAN        8.5133
- - - - - - - - - -

SUBSET  2

GROUP       GRP01         GRP03
MEAN       10.4750       11.5983
- - - - - - - - - - - - - - - - -

ANALYSIS OF VARIANCE--HYPOTHESIS 2                                        8 JUL 82 14:56:44       PAGE    5
COMPARISON OF ATT DATA PERIOD 1,2,3
```

ANALYSIS OF VARIANCE--HYPOTHESIS 3 8 JUL 82 15:11:40 PAGE 3
COMPARISON OF NMCM-U DATA PERIOD 1,2,3
FILE NONAME (CREATED 8 JUL 82 15:11:40)

- O N E W A Y -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	769.3337	384.6669	13.759	0.0000
WITHIN GROUPS	147	4109.8490	27.9582		
TOTAL	149	4879.1827			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	50	16.1440	5.3071	0.7505	2.0000	26.7000	14.6357 TO 17.6523
GRP02	50	11.5400	5.0097	0.7085	2.7000	26.4000	10.1163 TO 12.9637
GRP03	50	16.5220	5.5329	0.7825	6.4000	27.2000	14.9496 TO 18.0944
TOTAL	150	14.7353	5.7224	0.4672	2.0000	27.2000	13.8121 TO 15.6586
	FIXED EFFECTS MODEL		5.2875	0.4317			13.8821 TO 15.5885
	RANDOM EFFECTS MODEL			1.6014			7.8450 TO 21.6256

```
ANALYSIS OF VARIANCE--HYPOTHESIS 3                                    8 JUL 82 15:11:40        PAGE    4
COMPARISON OF NMCM-U DATA PERIOD 1,2,3
FILE     NONAME (CREATED   8 JUL 82 15:11:40)

- - - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - - - -

     VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
       3.7309 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)

SUBSET  1

GROUP       GRP02
MEAN       11.5400
- - - - - - - - - -

SUBSET  2

GROUP       GRP01        GRP03
MEAN       16.1440      16.5220
- - - - - - - - - - - - - - - -

ANALYSIS OF VARIANCE--HYPOTHESIS 3                                    8 JUL 82 15:11:40        PAGE    5
COMPARISON OF NMCM-U DATA PERIOD 1,2,3
```

ANALYSIS OF VARIANCE--HYPOTHESIS 4 8 JUL 82 15:35:08 PAGE 3
COMPARISON OF NMCM-S DATA PERIOD 1,2,3
FILE NONAME (CREATED 8 JUL 82 15:35:08)

- O N E W A Y -

VARIABLE B DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	1031.9941	515.9971	70.970	0.0000
WITHIN GROUPS	147	1068.7792	7.2706		
TOTAL	149	2100.7733			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	50	9.0360	3.4899	0.4935	2.3000	16.3000	8.0442 TO 10.0278
GRP02	50	3.1680	2.2367	0.3163	0.1000	11.2000	2.5323 TO 3.8037
GRP03	50	3.8360	2.1518	0.3043	0.1000	9.0000	3.2245 TO 4.4475
TOTAL	150	5.3467	3.7549	0.3066	0.1000	16.3000	4.7409 TO 5.9525
FIXED EFFECTS MODEL			2.6964	0.2202			4.9116 TO 5.7818
RANDOM EFFECTS MODEL				1.8547			-2.6336 TO 13.3270

```
ANALYSIS OF VARIANCE--HYPOTHESIS 4                                          8 JUL 82 15:35:08        PAGE    4
COMPARISON OF NMCM-S DATA PERIOD 1,2,3
FILE     NONAME (CREATED   8 JUL 82 15:35:08)

- - - - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - - - - - -

     VARIABLE    D        DATA

MULTIPLE RANGE TEST

DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
        1.9066 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)

SUBSET  1

GROUP        GRP02        GRP03
MEAN         3.1680       3.8360
- - - - - - - - - - - - - - - - -

SUBSET  2

GROUP        GRP01
MEAN         9.0360
- - - - - - - - - - -

ANALYSIS OF VARIANCE--HYPOTHESIS 4                                          8 JUL 82 15:35:08        PAGE    5
COMPARISON OF NMCM-S DATA PERIOD 1,2,3
```

ANALYSIS OF VARIANCE--HYPOTHESIS 5 8 JUL 82 15:46:40 PAGE 3
COMPARISON OF SCH-EFFNESS DATA PERIOD 1,2,3
FILE NONAME (CREATED 8 JUL 82 15:46:40)

- O N E W A Y -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	1635.2732	817.6366	9.226	0.0002
WITHIN GROUPS	162	14356.8553	88.6226		
TOTAL	164	15992.1285			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN		
GRP01	55	71.9527	10.0798	1.3592	45.3000	92.9000	69.2278	TO	74.6777
GRP02	55	79.0618	9.9886	1.3469	45.2000	97.1000	76.3615	TO	81.7621
GRP03	55	78.0945	8.0309	1.0829	61.8000	92.3000	75.9235	TO	80.2656
TOTAL	165	76.3697	9.8749	0.7688	45.2000	97.1000	74.8518	TO	77.8876
	FIXED EFFECTS MODEL		9.4140	0.7329			74.9225	TO	77.8169
	RANDOM EFFECTS MODEL			2.2261			66.7916	TO	85.9478

FILE NONAME (CREATED 8 JUL 82 15:46:40)

\- O N E W A Y -

VARIABLE D DATA

MULTIPLE RANGE TEST

DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

2.80 2.94

THE RANGES ABOVE ARE TABLE RANGES. THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
6.6567 * RANGE * SQRT(1/N(I) + 1/N(J))

HOMOGENEOUS SUBSETS (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)

SUBSET 1

GROUP	GRP01
MEAN	71.9527

SUBSET 2

GROUP	GRP03	GRP02
MEAN	78.0945	79.0618

ANALYSIS OF VARIANCE--HYPOTHESIS 6 9 JUL 82 13:26:13 PAGE 3
COMPARISON OF MX-MN HRS FR FLY HR DATA PERIOD 1,2,3
FILE NONAME (CREATED 9 JUL 82 13:26:13)

- O N E W A Y -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	357.0902	178.5451	1.[illegible]8	0.1739
WITHIN GROUPS	105	10541.3042	100.3934		
TOTAL	107	10898.3944			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN		
GRP01	36	41.7861	8.1617	1.3603	22.8000	70.9000	39.0246	TO	44.5476
GRP02	36	45.3389	9.6244	1.6041	25.0000	62.4000	42.0825	TO	48.5953
GRP03	36	45.8889	11.9138	1.9856	21.9000	76.7000	41.8579	TO	49.9199
TOTAL	108	44.3380	10.0923	0.9711	21.9000	76.7000	42.4128	TO	46.2631
	FIXED EFFECTS MODEL		10.0196	0.9641			42.4262	TO	46.2497

```
COMPARISON OF MX-MN HRS PR FLY HR DATA PERIOD 1,2,3
FILE      NONAME (CREATED   9 JUL 82 13:26:13)

- - - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - - - -

     VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.81  2.95

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
       7.0850 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)


SUBSET  1

GROUP      GRP01        GRP02        GRP03
MEAN      41.7861      45.3389      45.8889
- - - - - - - - - - - - - - - - - - - - - - - - -


ANALYSIS OF VARIANCE--HYPOTHESIS 6                                       9 JUL 82 13:26:13       PAGE    5
COMPARISON OF MX-MN HRS PR FLY HR DATA PERIOD 1,2,3

CPU TIME REQUIRED..    0.83 SECONDS
ELAPSED WALL TIME..     129 SECONDS
```

ANALYSIS OF VARIANCE--HYPOTHESIS 7 9 JUL 82 13:39:39 PAGE 3
COMPARISON OF GND-ABORT RATES DATA PERIOD 1,2,3
FILE NONAME (CREATED 9 JUL 82 13:39:39)

- - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	7.8265	3.9133	1.348	0.2626
WITHIN GROUPS	162	470.2149	2.9026		
TOTAL	164	478.0415			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	55	3.2164	1.8489	0.2493	0.4000	8.2000	2.7165 TO 3.7162
GRP02	55	2.9745	1.6792	0.2264	0.6000	9.2000	2.5206 TO 3.4285
GRP03	55	2.6836	1.5715	0.2119	0.1000	7.4000	2.2588 TO 3.1085
TOTAL	165	2.9582	1.7073	0.1329	0.1000	9.2000	2.6957 TO 3.2206
	FIXED EFFECTS MODEL		1.7037	0.1326			2.6963 TO 3.2201
	RANDOM EFFECTS MODEL			0.1540			2.2956 TO 3.6208

```
ANALYSIS OF VARIANCE--HYPOTHESIS 7                                          9 JUL 82 13:39:39       PAGE    4
COMPARISON OF GND-ABORT RATES DATA PERIOD 1,2,3
FILE     NONAME (CREATED   9 JUL 82 13:39:39)

- - - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - - - -

      VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

           2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
        1.2047 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)

SUBSET  1

GROUP       GRP03         GRP02         GRP01
MEAN        2.6836        2.9745        3.2164
- - - - - - - - - - - - - - - - - - - - - - - -

ANALYSIS OF VARIANCE--HYPOTHESIS 7                                          9 JUL 82 13:39:39       PAGE    5
COMPARISON OF GND-ABORT RATES DATA PERIOD 1,2,3

CPU TIME REQUIRED..    0.91 SECONDS
ELAPSED WALL TIME..     130 SECONDS
```

COMPARISON OF AIR-ABORT RATES DATA PERIOD 1,2,3
FILE NONAME (CREATED 9 JUL 82 13:50:09)

- - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	9.4278	4.7139	9.940	0.0001
WITHIN GROUPS	162	76.8240	0.4742		
TOTAL	164	86.2518			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	55	0.9255	0.7706	0.1039	0.0000	3.7000	0.7171 TO 1.1338
GRP02	55	1.1345	0.7691	0.1037	0.0000	3.8000	0.9266 TO 1.3425
GRP03	55	0.5564	0.4872	0.0657	0.0000	2.0000	0.4247 TO 0.6881
TOTAL	165	0.8721	0.7252	0.0565	0.0000	3.8000	0.7606 TO 0.9836
	FIXED EFFECTS MODEL		0.6886	0.0536			0.7663 TO 0.9780

```
ANALYSIS OF VARIANCE--HYPOTHESIS 8                                         9 JUL 82 13:50:09       PAGE    4
COMPARISON OF AIR-ABORT RATES DATA PERIOD 1,2,3
FILE     NONAME (CREATED   9 JUL 82 13:50:09)

- - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - - -

      VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

           2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
        0.4869 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS    (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                          SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)


SUBSET  1

GROUP        GRP03
MEAN         0.5564
- - - - - - - - - - -

SUBSET  2

GROUP        GRP01          GRP02
MEAN         0.9255         1.1345
- - - - - - - - - - - - - - - - - - -


ANALYSIS OF VARIANCE--HYPOTHESIS 8                                         9 JUL 82 13:50:09       PAGE    5
COMPARISON OF AIR-ABORT RATES DATA PERIOD 1,2,3
```

ANALYSIS OF VARIANCE--HYPOTHESIS 9 9 JUL 82 14:04:23 PAGE 3
COMPARISON OF CODE-3 RATES DATA PERIOD 1,2,3
FILE NONAME (CREATED 9 JUL 82 14:04:23)

- O N E W A Y -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	1501.1470	750.5735	11.454	0.0000
WITHIN GROUPS	162	10615.7575	65.5294		
TOTAL	164	12116.9045			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	55	36.3218	9.9424	1.3406	17.9000	54.8000	33.6340 TO 39.0096
GRP02	55	39.4236	7.3771	0.9947	22.9000	58.0000	37.4293 TO 41.4180
GRP03	55	32.0655	6.5813	0.8874	16.3000	43.8000	30.2863 TO 33.8446
TOTAL	165	35.9370	8.5956	0.6692	16.3000	58.0000	34.6157 TO 37.2583
	FIXED EFFECTS MODEL		8.0950	0.6302			34.6925 TO 37.1814
	RANDOM EFFECTS MODEL			2.1328			26.7601 TO 45.1139

```
ANALYSIS OF VARIANCE--HYPOTHESIS 9                                          9 JUL 82 14:04:23        PAGE    4
COMPARISON OF CODE-3 RATES DATA PERIOD 1,2,3
FILE     NONAME (CREATED   9 JUL 82 14:04:23)

- - - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - - - - -

      VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

           2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
        5.7240 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)


SUBSET  1

GROUP       GRP03
MEAN       32.0655
- - - - - - - - - -

SUBSET  2

GROUP       GRP01
MEAN       36.3218
- - - - - - - - - -

SUBSET  3

GROUP       GRP02
MEAN       39.4236
- - - - - - - - -
```

ANALYSIS OF VARIANCE--HYPOTHESIS 10 9 JUL 82 14:15:10 PAGE 3
COMPARISON OF CAN RATES DATA PERIOD 1,2,3
FILE NONAME (CREATED 9 JUL 82 14:15:10)

- O N E W A Y -

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	80.0394	40.0197	1.977	0.1417
WITHIN GROUPS	162	3278.5505	20.2380		
TOTAL	164	3358.5899			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	55	6.0945	3.4474	0.4648	0.0000	14.5000	5.1626 TO 7.0265
GRP02	55	7.5582	3.9761	0.5361	2.5000	20.6000	6.4833 TO 8.6331
GRP03	55	7.5855	5.7463	0.7748	0.4000	25.1000	6.0320 TO 9.1389
TOTAL	165	7.0794	4.5254	0.3523	0.0000	25.1000	6.3838 TO 7.7750
FIXED EFFECTS MODEL			4.4987	0.3502			6.3878 TO 7.7710
RANDOM EFFECTS MODEL				0.4925			4.9604 TO 9.1984

```
ANALYSIS OF VARIANCE--HYPOTHESIS 10                                   9 JUL 82 14:15:10       PAGE    4
COMPARISON OF CAN RATES DATA PERIOD 1,2,3
FILE     NONAME (CREATED   9 JUL 82 14:15:10)

- - - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - -

      VARIABLE    D        DATA

MULTIPLE RANGE TEST

DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
       3.1810 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                         SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)

SUBSET  1

GROUP       GRP01         GRP02         GRP03
MEAN        6.0945        7.5582        7.5855
- - - - - - - - - - - - - - - - - - - - - - - -

ANALYSIS OF VARIANCE--HYPOTHESIS 10                                   9 JUL 82 14:15:10       PAGE    5
COMPARISON OF CAN RATES DATA PERIOD 1,2,3
```

ANALYSIS OF VARIANCE
COMPARISON OF CONTRACT HOURS PERIOD 1,2,3 — 9 JUL 82 14:53:58 — PAGE 3
FILE NONAME (CREATED 9 JUL 82 14:53:58)

------------------------------ O N E W A Y ------------------------------

VARIABLE D DATA

ANALYSIS OF VARIANCE

SOURCE	D.F.	SUM OF SQUARES	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2	32227.5029	16113.7515	6.845	0.0014
WITHIN GROUPS	162	381390.4000	2354.2617		
TOTAL	164	413617.9029			

GROUP	COUNT	MEAN	STANDARD DEVIATION	STANDARD ERROR	MINIMUM	MAXIMUM	95 PCT CONF INT FOR MEAN
GRP01	55	461.2909	37.3381	5.0347	390.0000	542.0000	451.1970 TO 471.3848
GRP02	55	492.0727	56.5701	7.6279	392.0000	669.0000	476.7797 TO 507.3658
GRP03	55	463.7091	49.6837	6.6993	272.0000	574.0000	450.2777 TO 477.1405
TOTAL	165	472.3576	50.2201	3.9096	272.0000	669.0000	464.6379 TO 480.0773
FIXED EFFECTS MODEL			48.5207	3.7773			464.8984 TO 479.8167
RANDOM EFFECTS MODEL				9.8823			[illegible] TO [illegible]

```
ANALYSIS OF VARIANCE                                                  9 JUL 82 14:53:58       PAGE    4
COMPARISON OF CONTRACT HOURS PERIOD 1,2,3
FILE     NUNAME (CREATED   9 JUL 82 14:53:58)

- - - - - - - - - - - - - - - - - - - - - - - - - O N E W A Y - - - - - - - - - - - - - - - - - - - - - - - - -

     VARIABLE    D        DATA


MULTIPLE RANGE TEST


DUNCAN PROCEDURE
RANGES FOR THE 0.050 LEVEL -

          2.80  2.94

THE RANGES ABOVE ARE TABLE RANGES.  THE VALUE ACTUALLY COMPARED WITH MEAN(J)-MEAN(I) IS..
      34.3093 * RANGE * SQRT(1/N(I) + 1/N(J))
  HOMOGENEOUS SUBSETS   (SUBSETS OF GROUPS, WHOSE HIGHEST AND LOWEST MEANS DO NOT DIFFER BY MORE THAN THE SHORTEST
                        SIGNIFICANT RANGE FOR A SUBSET OF THAT SIZE)


SUBSET  1

GROUP       GRP01         GRP03
MEAN      461.2909      463.7091
- - - - - - - - - - - - - - - - -

SUBSET  2

GROUP       GRP02
MEAN      492.0727
- - - - - - - - - - -


ANALYSIS OF VARIANCE                                                  9 JUL 82 14:53:58       PAGE    5
COMPARISON OF CONTRACT HOURS PERIOD 1,2,3
```

LGE SAMP TEST OF SIG HYPOTHESIS 1 15 JUL 82 10:10:34 PAGE 2
FMC RATE PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 15 JUL 82 10:10:34)

T TEST

GROUP 1 - FIRST 60 CASES
GROUP 2 - NEXT 60 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
FMC FULL MISSION CAPABLE												
GROUP 1	60	63.7400	7.577	0.978	3.00	0.000	8.32	118	0.000	8.32	94.41	0.000
GROUP 2	60	47.4083	13.125	1.694								

LGE SAMP TEST OF SIG--HYPOTHESIS 1A 9 JUL 82 14:34:00 PAGE 2
FMCPMC DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 14:34:00)

T - T E S T

GROUP 1 - FIRST 60 CASES
GROUP 2 - NEXT 60 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
FMPMC FULL & PARTIAL MISSION CAPABLE												
GROUP 1	60	68.5833	6.220	0.803	1.22	0.448	1.17	118	0.245	1.17	116.86	0.245
GROUP 2	60	67.3167	5.633	0.727								

LGE SAMP TEST OF SIG--HYPOTHESIS 1B
PMCS DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 14:40:11)

9 JUL 82 14:40:11 PAGE 2

T - T E S T

GROUP 1 - FIRST 60 CASES
GROUP 2 - NEXT 60 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE: T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE: T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
PMCS PARTIAL MISSION CAPABLE-SUPPLY												
GROUP 1	60	3.1100	2.326	0.300	19.38	0.000	-8.59	118	0.000	-8.59	65.07	0.000
GROUP 2	60	14.7500	10.236	1.322								

LGE SAMP TEST OF SIG HYPOTHESIS 1C
PMCM RATE PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 22 JUL 82 12:19:44)

22 JUL 82 12:19:44 PAGE 2

T - T E S T

GROUP 1 - FIRST 60 CASES
GROUP 2 - NEXT 60 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE: T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE: T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
PMCM PARTIAL MISSION CAPABLE-MAINT												
GROUP 1	60	1.4283	1.856	0.240	3.82	0.000	-4.77	118	0.000	-4.77	87.92	0.000
GROUP 2	60	3.9367	3.627	0.468								

T&E SAMP TEST OF SIG--HYPOTHESIS 2 — 8 JUL 82 15:00:35 — PAGE 2

ATT DATA PERIOD 1 VS PERIOD 3

FILE NONAME (CREATED 8 JUL 82 15:00:35)

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GROUP 1 - FIRST 60 CASES

GROUP 2 - NEXT 60 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE: T VALUE	POOLED: DEGREES OF FREEDOM	POOLED: 2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE: T VALUE	SEPARATE: DEGREES OF FREEDOM	SEPARATE: 2-TAIL PROB.
ATT AVG TURNAROUND TIME												
GROUP 1	60	10.4750	3.822	0.493	1.05	0.848	-1.59	118	0.115	-1.59	117.93	0.115
GROUP 2	60	11.5983	3.919	0.506								

LGE SAMP TEST OF SIG--HYPOTHESIS 3 — 8 JUL 82 15:28:10 — PAGE 2

NMCM-U DATA PERIOD 1 VS PERIOD 3

FILE NONAME (CREATED 8 JUL 82 15:28:10)

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GROUP 1 - FIRST 50 CASES

GROUP 2 - NEXT 50 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE: T VALUE	POOLED: DEGREES OF FREEDOM	POOLED: 2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE: T VALUE	SEPARATE: DEGREES OF FREEDOM	SEPARATE: 2-TAIL PROB.
NMCU NOT MSN CAPABLE MX-UNSCH												
GROUP 1	50	16.1440	5.307	0.751	1.09	0.772	-0.35	98	0.728	-0.35	97.83	0.728
GROUP 2	50	16.5220	5.533	0.782								

LGE SAMP TEST OF SIG--HYPOTHESIS 4   8 JUL 82 15:36:39   PAGE 2
NMCM-S DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 8 JUL 82 15:36:39)

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GROUP 1 - FIRST 50 CASES
GROUP 2 - NEXT 50 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	POOLED DEGREES OF FREEDOM	POOLED 2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	SEPARATE DEGREES OF FREEDOM	SEPARATE 2-TAIL PROB.
NMCS NOT MSN CAPABLE MX-SCH												
GROUP 1	50	9.0360	3.490	0.494	2.63	0.001	8.97	98	0.000	8.97	81.55	0.000
GROUP 2	50	3.8360	2.152	0.304								

LGE SAMP TEST OF SIG--HYPOTHESIS 5   9 JUL 82 13:16:11   PAGE 2
SCH EFFECTIVENESS DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 13:16:11)

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GROUP 1 - FIRST 55 CASES
GROUP 2 - NEXT 55 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	POOLED DEGREES OF FREEDOM	POOLED 2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	SEPARATE DEGREES OF FREEDOM	SEPARATE 2-TAIL PROB.
SE SCHEDULING EFFECTIVENESS												
GROUP 1	55	71.9527	10.080	1.359	1.57	0.099	-3.53	108	0.001	-3.53	102.89	0.001
GROUP 2	55	78.0891	8.035	1.083								

LGE SAMP TEST OF SIG--HYPOTHESIS 6 9 JUL 82 13:29:46 PAGE 2
MXMH-HRS PER FLY HR DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 13:29:46)

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GROUP 1 - FIRST 36 CASES
GROUP 2 - NEXT 36 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
MXMH MX-MAN HRS PER FLY HR												
GROUP 1	36	41.7861	8.162	1.360	2.13	0.028	-1.70	70	0.093	-1.70	61.92	0.093
GROUP 2	36	45.8869	11.914	1.986								

LGE SAMP TEST OF SIG--HYPOTHESIS 7 9 JUL 82 13:43:19 PAGE 2
GND-ABORT RATES DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 13:43:19)

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GROUP 1 - FIRST 55 CASES
GROUP 2 - NEXT 55 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
GABR GROUND ABORT RATES												
GROUP 1	55	3.2764	1.904	0.257	1.47	0.161	1.78	108	0.078	1.78	104.24	0.078
GROUP 2	55	2.6836	1.571	0.212								

LDE SAMP TEST OF SIG--HYPOTHESIS 8 9 JUL 82 13:5o:25 PAGE 2
AIR-ABORT RATES DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 13:5o:25)

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GROUP 1 - FIRST 55 CASES
GROUP 2 - NEXT 55 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
AABK AIR ABORT RATES												
GROUP 1	55	0.9255	0.771	0.104	2.50	0.001	3.00	108	0.003	3.00	91.22	0.003
GROUP 2	55	0.5564	0.487	0.066								

LDE SAMP TEST OF SIG--HYPOTHESIS 9 9 JUL 82 14:08:02 PAGE 2
CODE-3 DESCREP RATES DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 14:08:02)

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GROUP 1 - FIRST 55 CASES
GROUP 2 - NEXT 55 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
CD3 CODE-3 DESCREPANCY RATES												
GROUP 1	55	36.3218	9.942	1.341	2.28	0.003	2.65	108	0.009	2.65	93.70	0.010
GROUP 2	55	32.0655	6.581	0.887								

LGE SAMP TEST OF SIG--HYPOTHESIS 10 — 9 JUL 82 14:18:41 — PAGE 2
CAN DESCREP RATES DATA PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 14:18:41)

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GROUP 1 - FIRST 55 CASES
GROUP 2 - NEXT 55 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
CAN CANNIBALIZATION RATES												
GROUP 1	55	6.0945	3.447	0.465	2.78	0.000	-1.65	108	0.102	-1.65	88.41	0.103
GROUP 2	55	7.5855	5.746	0.775								

LGE SAMP TEST OF SIGNIFICANCE — 9 JUL 82 14:47:08 — PAGE 2
CONTRACT HOURS PERIOD 1 VS PERIOD 3
FILE NONAME (CREATED 9 JUL 82 14:47:[illegible]

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GROUP 1 - FIRST 55 CASES
GROUP 2 - NEXT 55 CASES

VARIABLE	NUMBER OF CASES	MEAN	STANDARD DEVIATION	STANDARD ERROR	F VALUE	2-TAIL PROB.	POOLED VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.	SEPARATE VARIANCE ESTIMATE T VALUE	DEGREES OF FREEDOM	2-TAIL PROB.
CH CONTRACT HOURS												
GROUP 1	55	461.2909	37.338	5.035	1.77	0.038	-0.29	108	0.773	-0.29	100.25	0.774
GROUP 2	55	463.7091	49.684	6.699								

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